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March 1951

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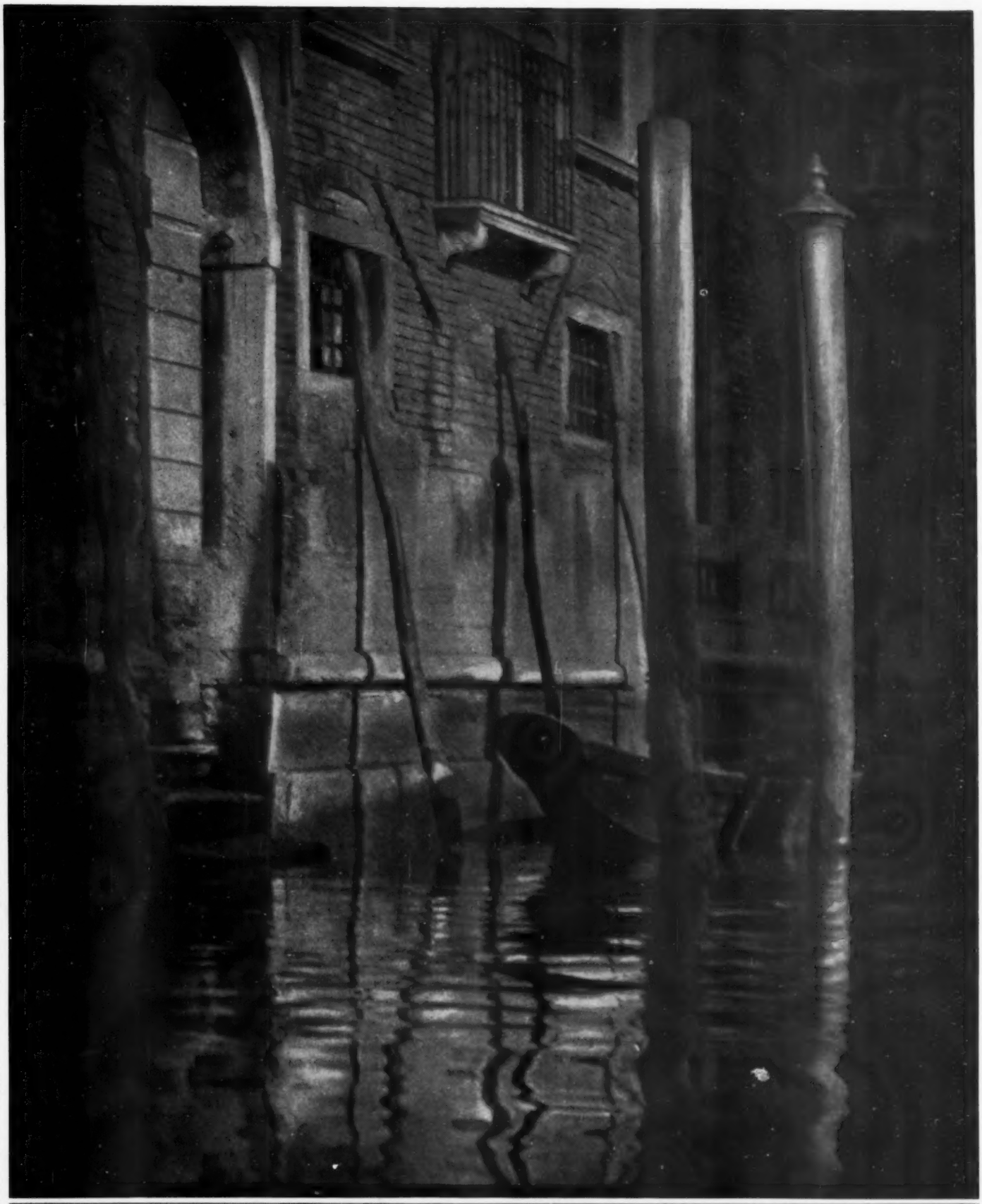

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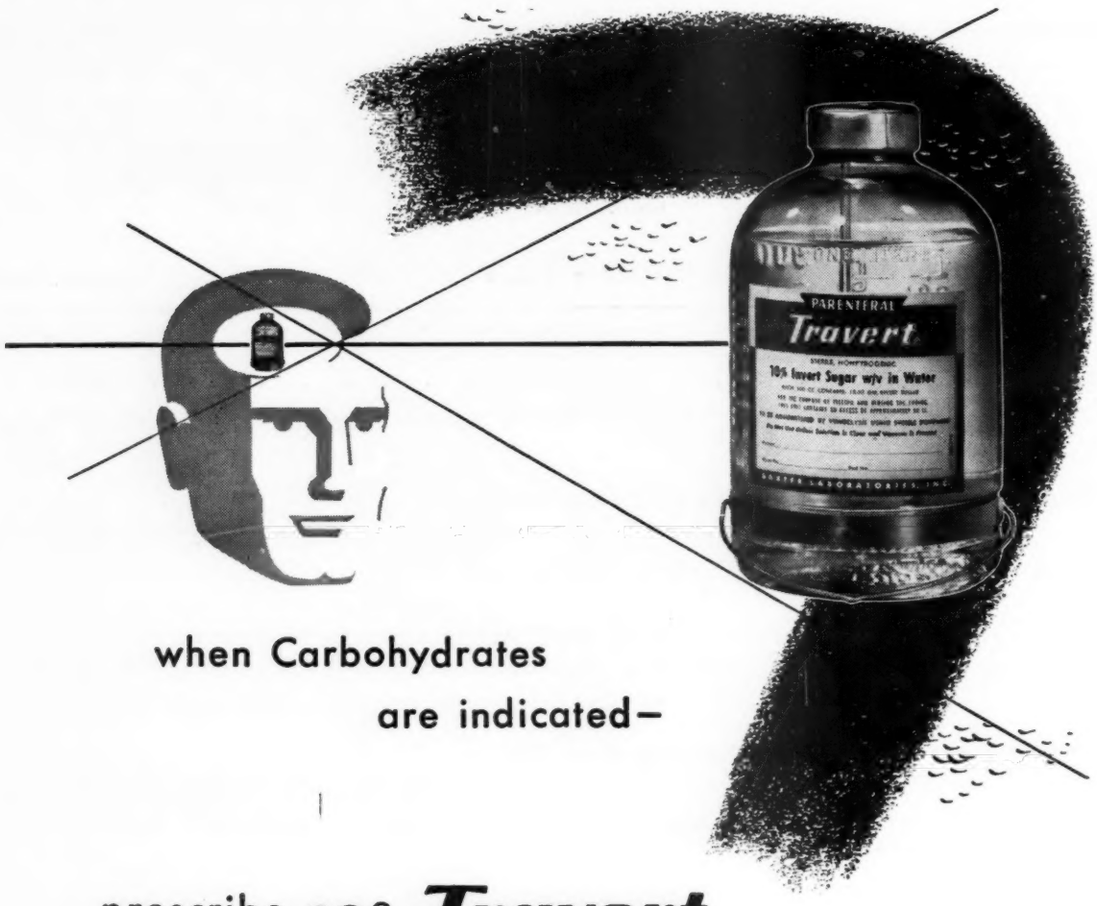

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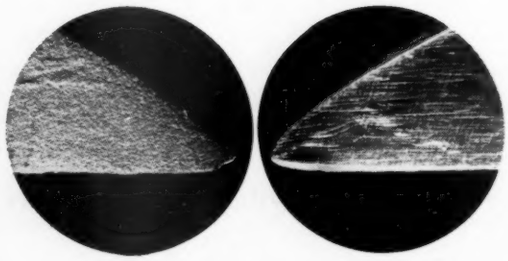

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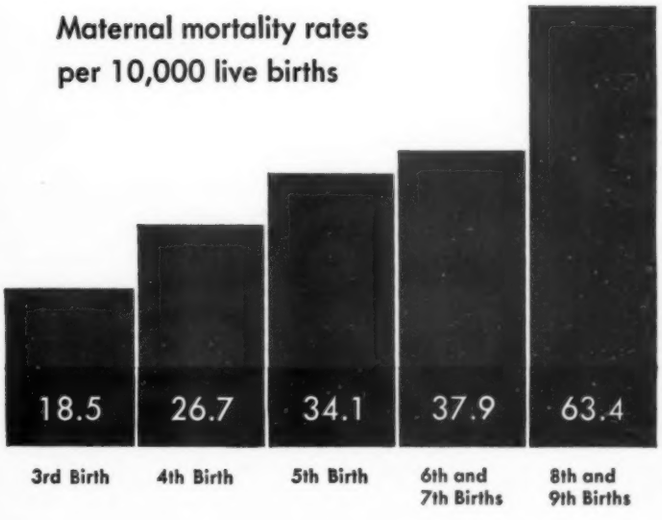

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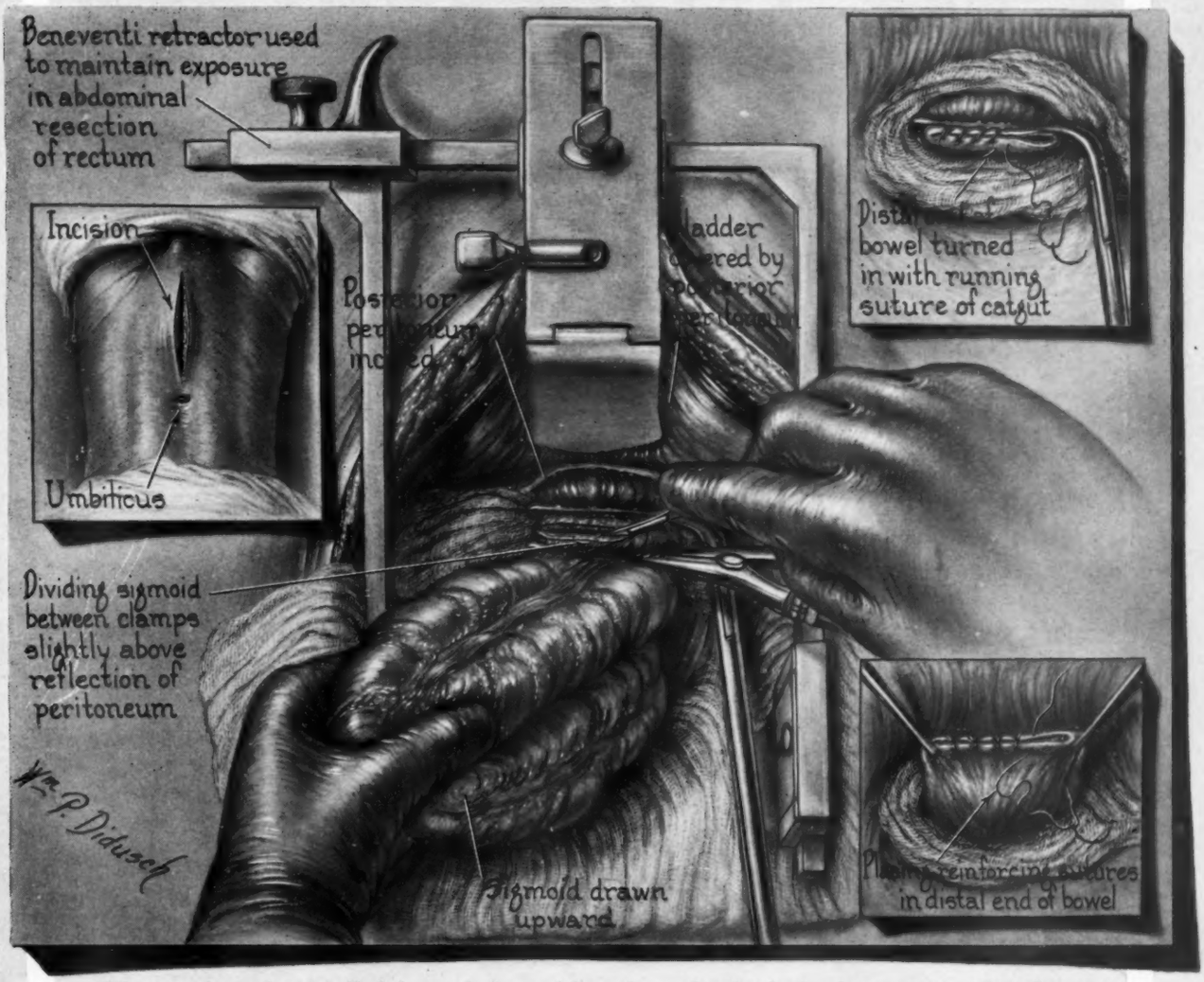
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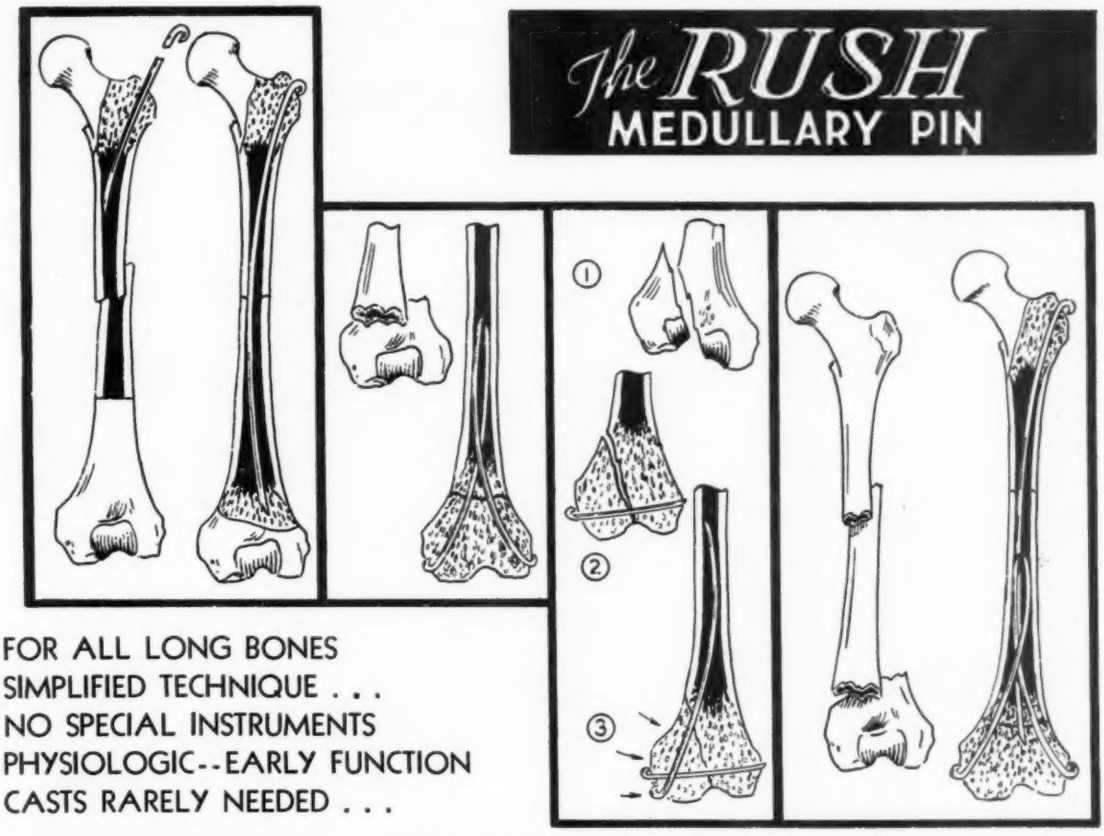

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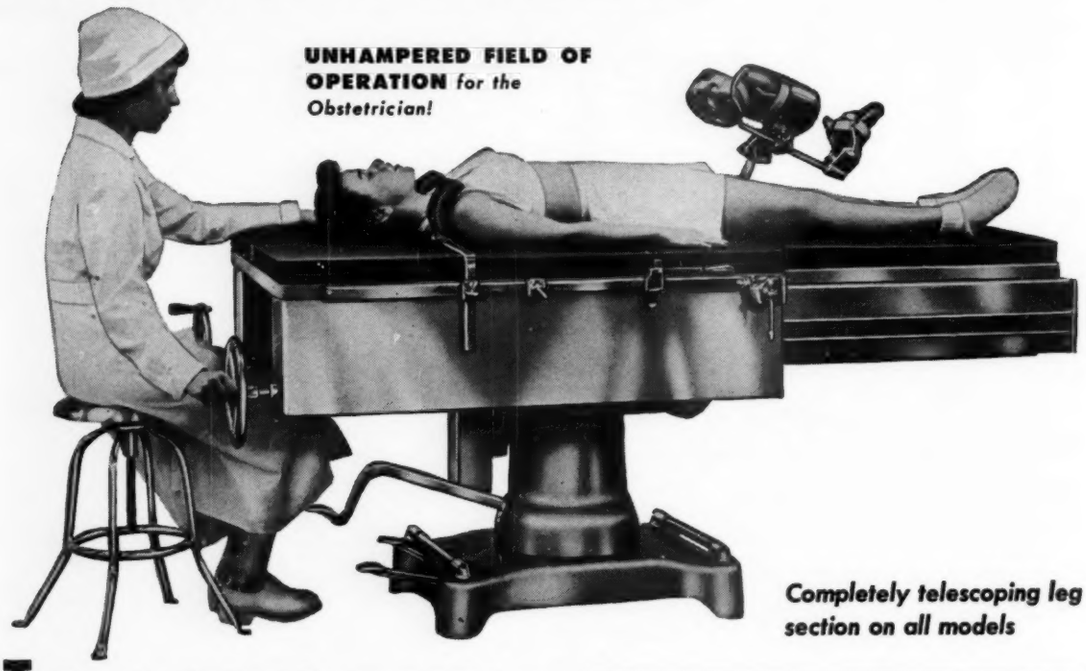

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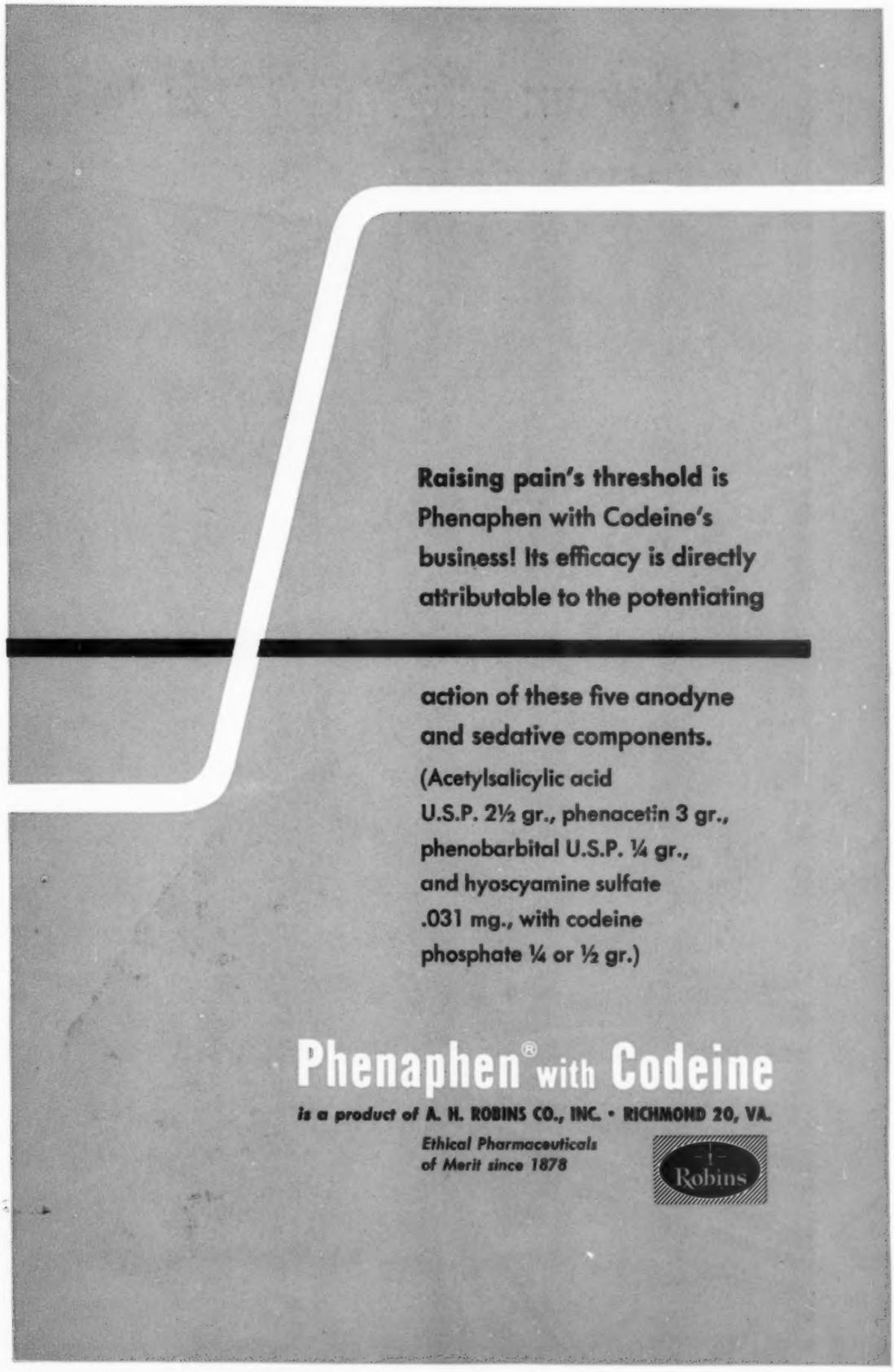
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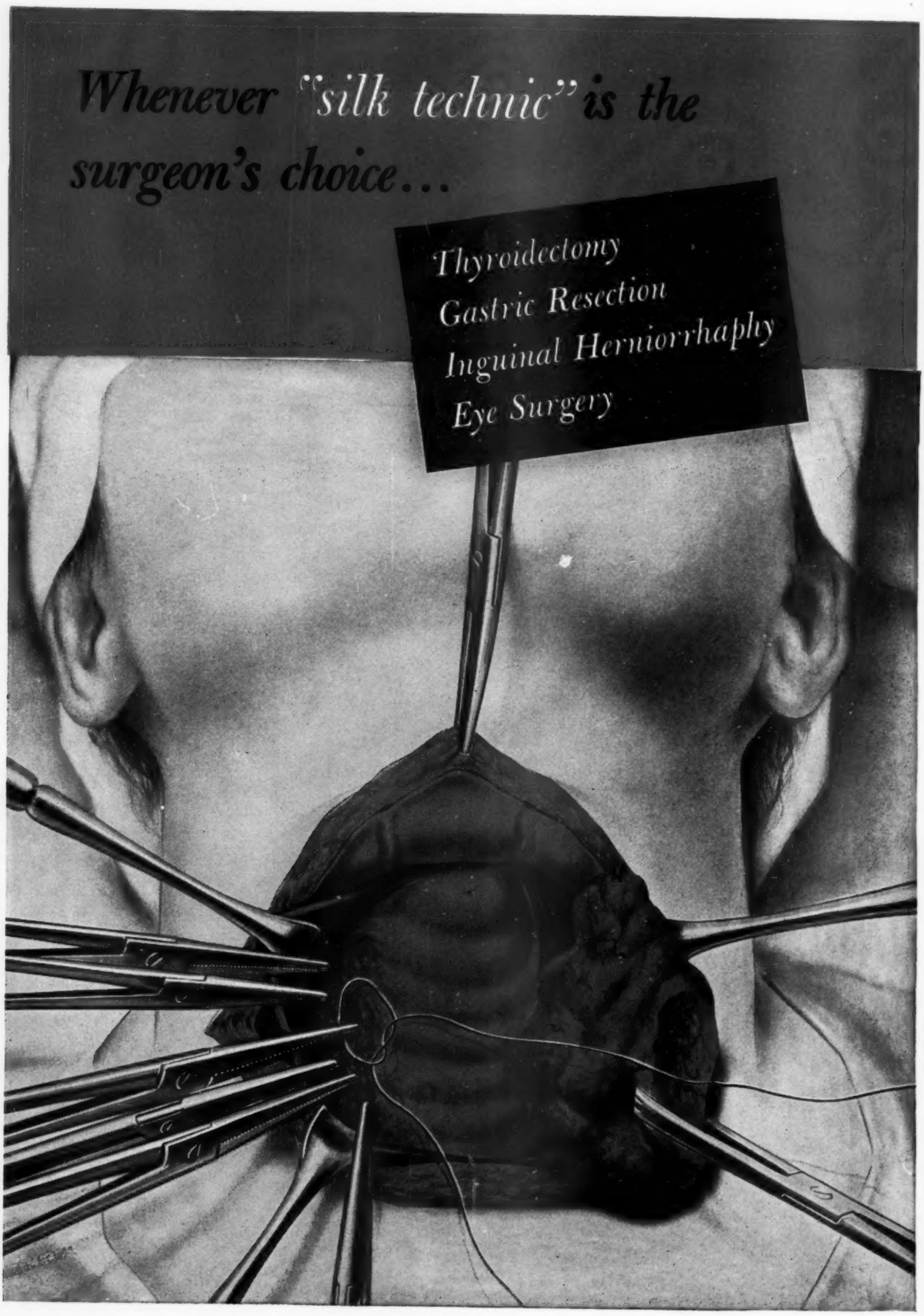
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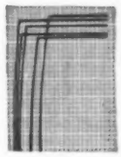
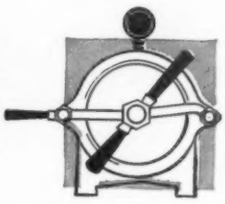
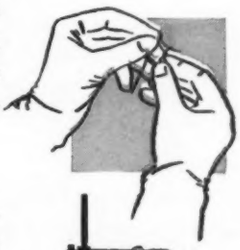


1 *Greater tensile strength:* One of the strongest silks ever created — smaller diameter sizes can be used everywhere to minimize trauma and foreign body reaction.



2 *Withstands repeated sterilization:* New Anacap Silk can be boiled or autoclaved ***six separate times*** without appreciable change in either strength or texture. In laboratory tests almost the full original strength is maintained even after 23½ hours of boiling.



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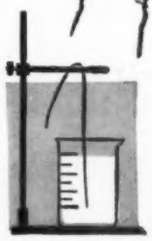

4 *Absolute non-capillarity:* Having no wick-like action, new Anacap Silk is resistant to body fluids and will not spread an early localized infection if it occurs.

5 *Doubly economical:* Low in original purchase price, new Anacap Silk is also low in individual suture cost because of its long sterilization life.

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*McGivney, J.: *Factors Influencing the Healing of Anorectal Surgical Wounds*, South. M. J. 41:401, 1948 • Koontz, E.: *Streptomycin and Surgery in Anorectal Tuberculosis*, Surg. Clin. N. A. 28:1643, 1948.

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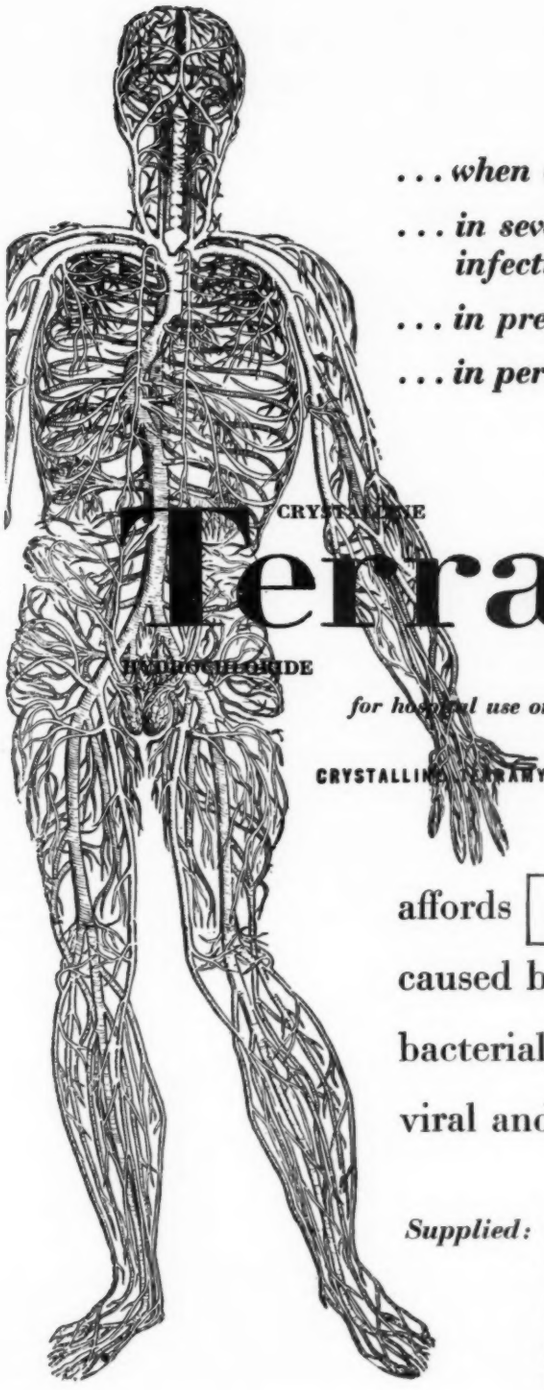

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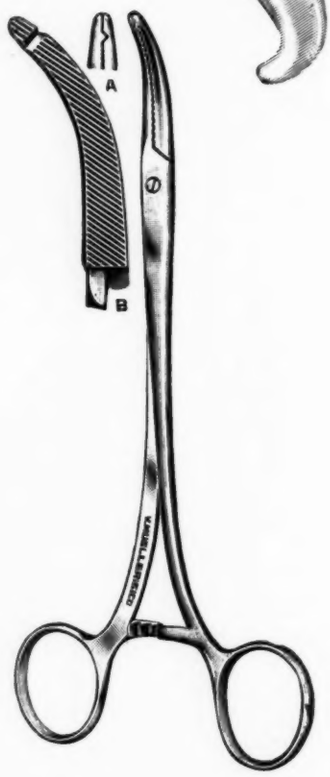

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•

1. Kochakian, C. D.: Am. J. Physiol. 158:51, 1949.

2. Gordan, G. S. et al: Address to Association for the Study of Internal Secretion, (June 23) 1950.

3. Homburger, F., Kasdon, S. C., and Fishman, W. H.: Proc. Soc. Exper. Biol. and Med. 74:162, 1950.

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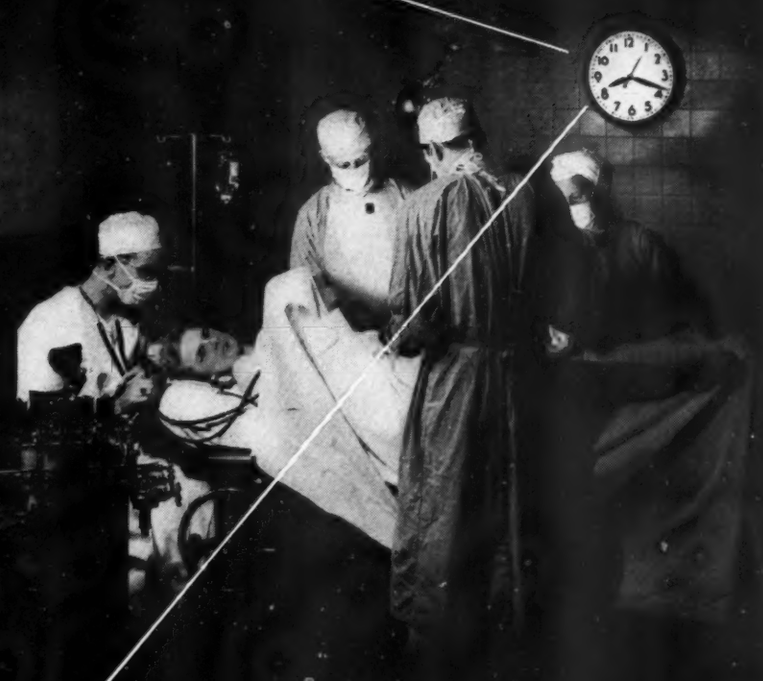

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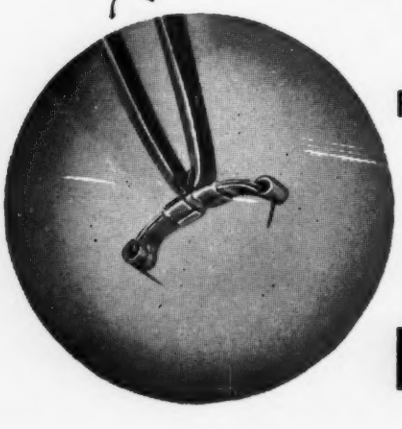

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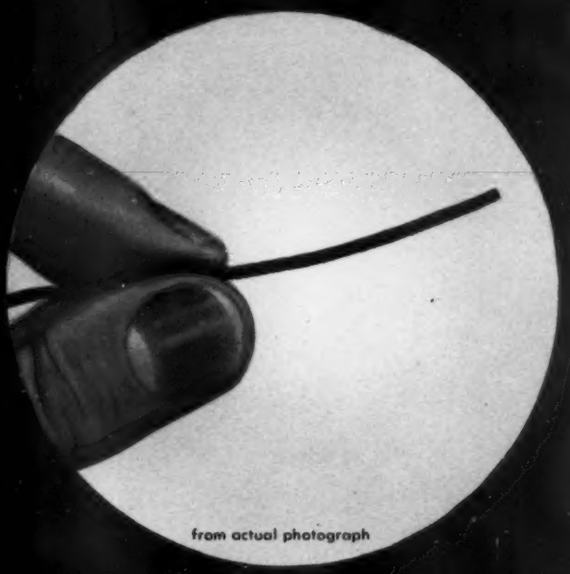

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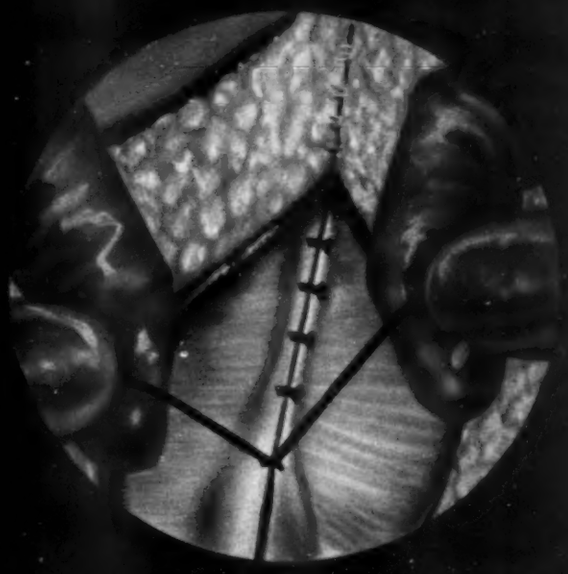

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Although the manufacture of Cortone—probably the most intricate and lengthy synthesis ever undertaken—has imposed unprecedented difficulties, every effort is being made to increase production and, in the meantime, to achieve an equitable national distribution of this vital drug.

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Among the conditions in which Cortone has produced striking clinical improvement are:

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IN Brooklyn there is an organization called the Brooklyn Chapter of the American College of Surgeons. This body considers and interviews all candidates for admission and reports to the parent body its findings and recommendations. Also, twice a year the members of this Chapter visit a distant medical center, spending about two days attending operative and dry clinics and having round table discussions. From forty to seventy-five people, of a membership of nearly 400, go on these pilgrimages. Last January they attended the Guthrie Clinic at Sayre, Pennsylvania, where an attractive program had been prepared. It was voted that Dr. Guthrie and his co-workers were perfect and more than generous hosts and the program arranged was valuable and very worth while in every respect. We were sorry we could not attend, as we have published many excellent papers from the Guthrie Clinic staff.

THE United States has a lower death rate than Australia for a number of the important infectious diseases including the principal communicable diseases of childhood, tuberculosis, and influenza and pneumonia. On the other hand, we have a higher death rate from the diseases common in middle and later life such as the heart diseases and cancer, and from accidents. A 9,000,000 gain since 1940 in population at ages twenty-five to sixty-four, the main source of industrial and agricultural manpower, places the United States in a better position than ever before to expand its productivity for national defense, according to the statisticians of the Metropolitan Life Insurance Company.

DEAN Young of Columbia University states, "Medical education is undoubtedly one of the most expensive phases of our University program." The Harkness Fund will help considerably, but much more will be needed to carry out the vital work of the medical school.

"The impressive number of corporations in our list of donors is highly significant. Columbia is looking increasingly to commerce and industry for support, and it is indeed gratifying to see scholarship and other types of aid from such firms as E. I. du Pont De Nemours and Company, the Texas Company, the General Electric Company, Hoffman La Roche, Inc., Crosley Broadcasting Company, Remington Rand, Inc., Socony-Vacuum Laboratories, Eli Lilly and Company and the Bigelow-Sanford Carpet Company."

A MECHANICAL heart that may some day help doctors when they open the human heart directly for surgical repairs has been devised by two Yale surgeons. The mechanical heart, which has been used successfully on dogs, is actually a pump that takes over the functions of the right side of the heart for a limited time. During this time the right side of the heart is temporarily free of circulating blood and thus will give the surgeon a better chance to operate without fear of stopping the circulation. The two Yale doctors are William H. Sewell who started working on the pump while still a student at the Yale School of Medicine and William W. L. Glenn, Assistant Professor of Surgery.

Their report explains that the mechanical heart has been used on dogs for periods as long as 100 minutes. The animals remained in good condition throughout the period and have recovered completely from the experiments. Dr. Sewell and Dr. Glenn emphasize, however, that their pump has not been perfected enough for tests on human beings.

ABOUT 30,000 American girls and women lose their lives in accidents each year which is a higher toll than from any other cause of death except the cardiovascular renal diseases or cancer, according to the statisticians of the Metropolitan Life Insurance Company. During the childhood and adolescent years accidents are the greatest single threat to life for females. Falls rank first among the causes of fatal accidents to females, accounting for 45 per cent of the total number of fatalities. This is due in large measure to the high toll of life taken by falls among women of the age of sixty-five and over.

"Impaired vision and hearing, weakened skeletal muscles and other physical deterioration make the aged prone to falls," the statisticians comment. "Accidents of this kind which ordinarily cause little disability at the younger ages, often result seriously for older people."

(*continued on page 28*)

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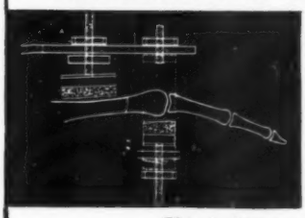

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Outside the Ivory Tower

(*continued from page 26*)

HERE is evidence that the good old days in some respects were not so good after all. Forty years ago the loss of life through scalds or burns was seven times as high as it is today. Even as recently as the period of 1936 to 1940 the average death rate was double last year's. This is based on the experience among the industrial policyholders of the Metropolitan Life Insurance Company, and the improvement, according to the company's safety experts, is due largely to the modernization of the American home with its improved heating, cooking and lighting facilities.

"The trend reflects in some measure the effect of consistent and widespread education for safety, and the marked advances which medical science has made in the treatment of severe burns," declared Dr. Donald B. Armstrong, second vice-president in charge of the Metropolitan's health and welfare activities. "But most important has been the passing of the old fashioned coal or wood stove, the kerosene lamp and other hazards of past years."

Even now burns and scalds claim about 4,600 lives yearly in the United States, and many additional thousands suffer serious and disfiguring injuries which do not prove fatal, the company's statisticians report.

NORTHWESTERN University's Medical School announced a new program for nurses which offers a bachelor of science degree in nursing in addition to the diploma in nursing. Dr. Theodore R. Van Dellen, assistant dean of the Medical School, emphasized that there has been a definite need for such a program. "This course of training will make it less difficult for women students in nursing to obtain a bachelor of science degree," he said. "The plan will provide better education for nurses and at the same time will speed up the course of training." (Sounds fine—but are these young ladies going to nurse sick people or be desk generals? Editor)

MEASURE of the revolutionary advances brought about by the so-called miracle drugs in the control of the infectious diseases is provided by the fact that for every person who dies of pneumonia now three or four succumbed to the disease as recently as fifteen years ago. Among industrial policyholders of the Metropolitan Life Insurance Company the average annual death rate for pneumonia has fallen progressively from about sixty-eight per 100,000 for the period of 1935 to 1937, to thirty-three for 1940 to 1942, and to twenty for 1947 to 1949.

CORONARY thrombosis, contrary to popular impression, is not usually fatal immediately or within a short time. Results of a study by Metropolitan Life Insurance Company statisticians show that 70 per cent of a group of persons who had had one or more coronary attacks were still alive at the end of five years, 50 per cent at the end of ten years and 43 per cent at the end of twelve years. The study traces survivorship among 540 men for whom life insurance disability benefits were approved because of heart conditions.

DR. Russell Landram Haden, medical educator and recently head of the Department of Medicine at the Cleveland, Ohio, Clinic, was appointed medical director of the Red Cross National Blood Program. Dr. Haden will direct the medical aspects of the blood program as it is expanded to provide blood, plasma and other derivatives for the nation's hospitals and for military and civil defense needs. He will work with Dr. Ross T. McIntire, chairman of the blood program's committee on medical policies and procedures. This committee of leading surgeons and hematologists is supervising the planning and development of Red Cross blood collection centers and the coordination of the country's private and institutional blood banks in carrying out the responsibilities assigned Red Cross by the military and defense authorities.

The Red Cross national blood program is now operating thirty-five regional blood collection centers and is in process of adding seven more to the network. Civil Defense centers for the procurement of blood to meet the demands of defense preparedness are also being established in a number of metropolitan areas. Dr. Haden succeeds Dr. Louis K. Diamond, Boston hematologist and a member of the Harvard Medical School faculty, who resigned to return to his duties at Harvard and at Children's Hospital where he is director of the blood bank and research laboratory.

(*continued on page 40*)

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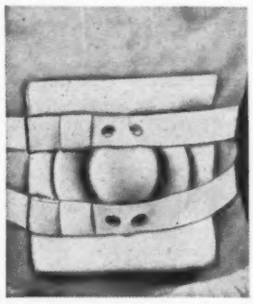

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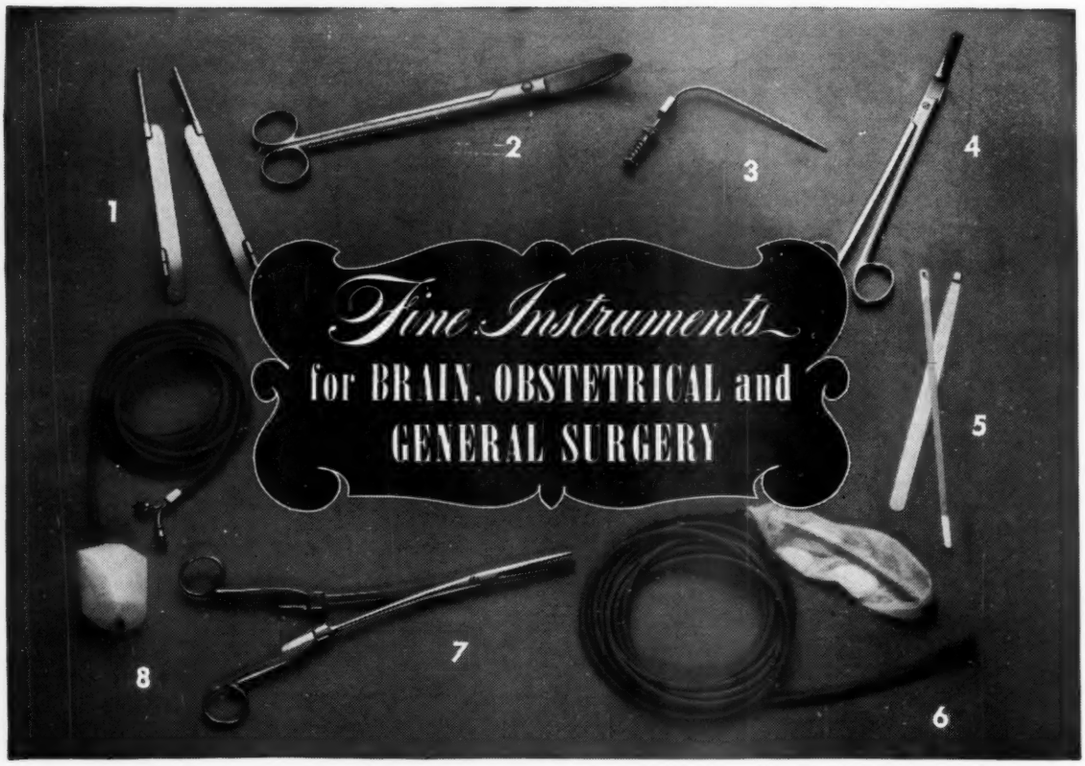

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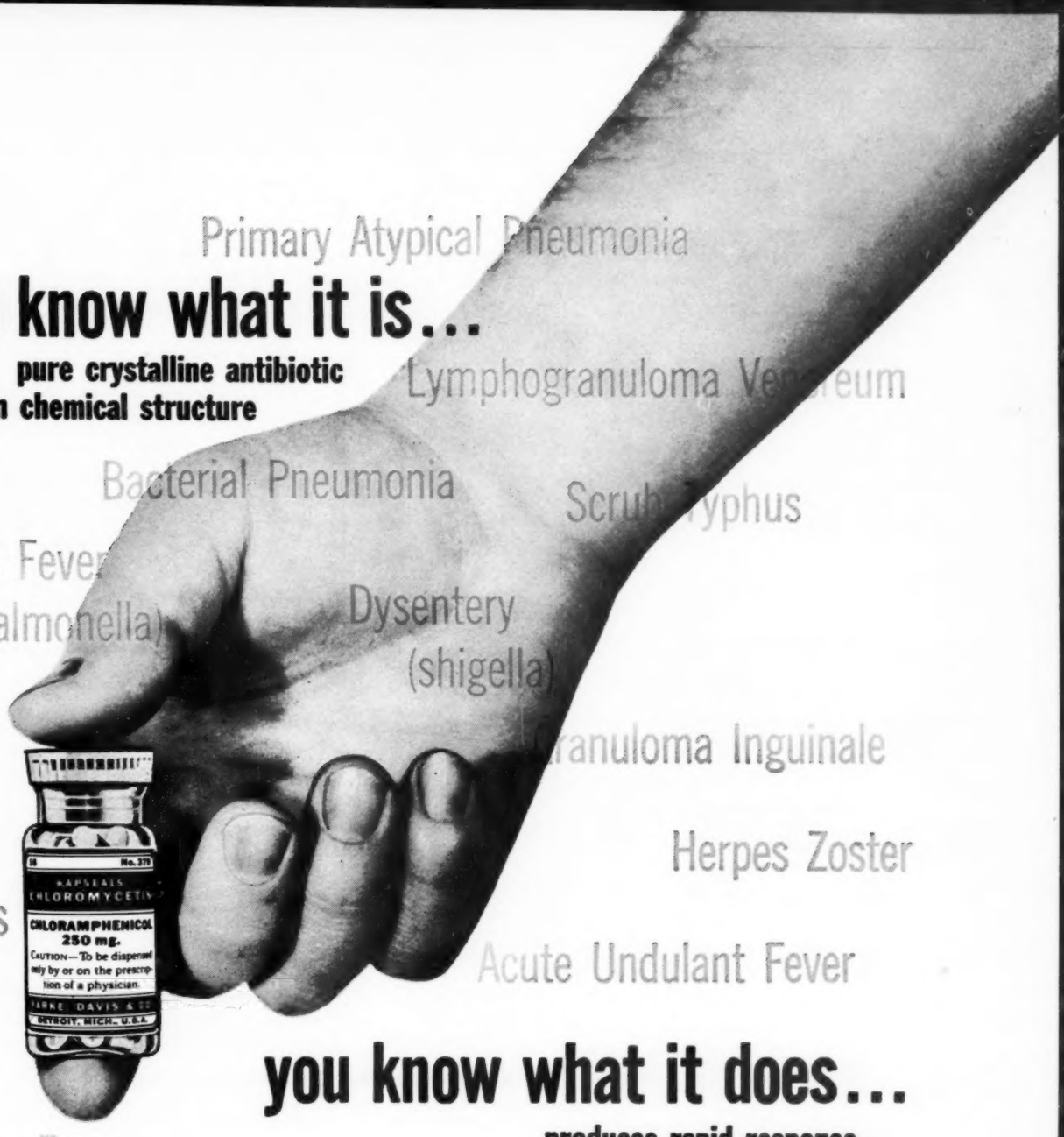

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Editorial

TREATMENT OF ATOMIC BOMB INJURIES*

THE EMERGENCY TREATMENT OF WOUNDS, SHOCK, BURNS AND FRACTURES

THE physician's first function is to examine rapidly and sort casualties to determine priorities for treatment. Moribund patients should be made comfortable and left alone. Slightly wounded patients should be allowed to wait or evacuate themselves. Attention should be directed to the seriously wounded. The doctor must improvise with whatever equipment and medications are available. Definitive treatment must be done in hospitals or emergency centers. This outline concerns itself only with emergency or first aid, on the spot treatment.

PRIORITIES IN TREATMENT AND TRANSPORTATION

1. Massive hemorrhage
2. Chest wounds
3. Shock
4. Abdominal wounds
5. Burn and crush injuries
6. Head and spine injuries

TREATMENT OF EXTENSIVE WOUNDS

1. Triage
   - (A) Tagging
   - (B) Classify: slightly wounded
     seriously wounded
     mortally wounded
2. Morphine
   - (A) Use good doses, i.e., ½ gr.
   - (B) Note *time, dosage* and *route of administration* on tag
   - (C) Avoid in unconscious cases or suspected brain injury
   - (D) Avoid repetition in shock (delayed absorption)
3. Foreign bodies: leave alone
4. Hemorrhage: control by pressure dressing; tourniquet rarely needed
5. Wound: expose and apply sterile dressing; otherwise leave alone

HEMORRHAGE

1. Pressure dressing and maintain pressure
2. Elevate part
3. Tourniquet rarely needed; if used should be released after two hours and reapplied only if bleeding recurs
4. Litter case
5. Morphine
6. First priority for evacuation

WOUNDS OF THORAX

1. Sucking wound; immediate occlusive pressure dressing
2. Litter case

* We publish this article with permission of Dr. Martin J. Healy, Jr., Assistant Chief of Surgical Service, Veterans Administration Hospital, Bronx, N.Y., believing it may serve as a basis for the treatment of atomic bomb injuries. Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are a result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

3. Morphine
4. First priority for evacuation

SHOCK AND CRUSHING INJURIES

Step Sequence:
1. Arrest hemorrhage if present
2. Morphine, ½ gr., mark on tag; avoid repetition
3. Immobilize fractures on spot before moving
4. Warmth; blanket over and under patient
5. Blood, plasma, intravenous saline, oral saline; in order of availability
6. Keep recumbent; slight elevation of lower extremities

After first aid has been rendered:
1. Avoid repetition of morphine except for extreme restlessness
2. Barbiturates to allay apprehension
3. Oxygen if available; maintain airway; tracheostomy
4. If vomiting turn to prone position or use nasogastric tube
5. Continue fluid therapy; blood, plasma, saline; avoid fluids containing potassium, e.g., fruit juices
6. Check urinary output; if oliguric limit fluid intake to 2,500 cc./day until recovery; limit saline to 800 to 1,000 cc. daily

ABDOMINAL WOUNDS

1. Simple massive sterile dressing
   (A) Do not replace viscera
   (B) Do not remove foreign bodies
   (C) Do not manipulate or explore wound
2. Litter case
3. Morphine
4. Nothing by mouth
5. Priority for evacuation; after hemorrhage, chest wounds and shock; before head and extremity injuries

BURNS

On the scene treatment:
1. Morphine and tag
2. Simple clean dressing to burned areas
3. Constricting clothing slit; do not remove unnecessarily as this may be the patient's only protection
4. Examine for shock and other injuries and render appropriate first aid
5. Litter case unless burns are minor
6. Establish priority for evacuation

Treatment in Center or if evacuation is delayed:
1. Evaluate extent of burn
2. Blood; plasma; intravenous saline; oral saline
3. No débridement; no sprays; no tannic acid; no blisters opened
4. Local wound treatment, vaseline gauze, plain fine mesh gauze, clean sheet
5. Add any bulky absorbent material, mechanics waste, fluffed gauze, absorbent cotton
6. Moderate pressure with roll bandage, strips of any material; avoid tight or constricting bandages
7. Morphine
8. Antibiotics
9. Cortisone (?)

Estimating surface involved:

Head	7%
Trunk	34%
Arms	19%
Legs	40%
	100%

Estimation of daily fluid requirements:

Formula	
For each 1 per cent of body surface burned give	
75 cc. blood or plasma	cc.
plus 75 cc. electrolyte (Hartmann's or saline)	cc.
Normal daily requirement	2–3,000 cc.
Daily total	cc.

1. Give in divided doses; ½ in first eight hours, ½ over rest of day
2. Check urinary output; if oliguric reduce intake to 2,500 cc./day and not more than 1,000 cc. saline

Emergency oral fluid:

1-2-3-Formula	
Water	1 gallon
Sodium bicarbonate (baking soda)	2 tablespoonsful
Salt	3 tablespoonsful

BRAIN AND SPINAL CORD INJURIES

1. When in doubt treat as central nervous system injury
2. Litter case
3. Prone position

4. Padding under lower chest
5. Maintenance of airway
6. Immobilize by padding
7. No morphine except for extreme restlessness
8. Lesser priority for evacuation

MASSIVE WOUNDS OF EXTREMITIES

1. Control of hemorrhage
   (A) Pressure as rule
   (B) Ligation only if facilities are available
   (C) Tourniquets rarely
2. Simple sterile dressing
3. Morphine
4. Litter case
5. If crush injury; note on tag
6. Lesser evacuation priority

CLOSED FRACTURES

1. Skull: prone position, face to one side; no morphine; evacuate
2. Upper extremity
   (A) Shoulder, arm, elbow: sling and body bandage
   (B) Forearm, wrist, hand: splint of basswood, magazine, newspaper
3. Lower extremity
   (A) Thomas splint if available
   (B) Wooden splint, broomstick or tie legs together
   (C) Simple splint for foot fracture to keep blanket from resting on toes
4. Spine:
   (A) Cervical: face up on litter; immobilize head
   (B) Dorsal, lumbar: prone position, head to one side

COMPOUND FRACTURES

Same treatment as for closed fractures, but in addition:

1. Note compounding on patient's tag
2. Dry sterile dressing
3. Antibiotics

MATERIALS TO BE USED

Preference	First Substitute	Second Substitute
Casualty tag	Blank tag	Paper and pin
Morphine syrettes	Morphine solution	Morphine individual type
Emergency medical dressing—sterile	Sterile dressings	Clean sheets, shirts, etc.
Vaseline gauze packets	Sterile vaseline gauze	Dry dressing
Thomas splint	Basswood splints, broomsticks, etc.	Immobilize to trunk or opposite lower extremity
Blood or plasma	Intravenous isotonic salines (? blood substitutes)	Oral saline 4–6,000 cc. daily

Correction: The Editor wishes to call attention to an error in the address of Dr. Moon on page 1 of the January 1951 issue. We inadvertently printed Kansas City, Missouri, as Dr. Moon's address instead of Omaha, Nebraska. This error has been corrected in his reprints and in the bound transactions of The American Proctologic Society.

Original Articles

MYELOGRAPHIC DEFECTS OF HERNIATED INTERVERTEBRAL DISCS SIMULATING CAUDA EQUINA NEOPLASMS*

ABRAHAM KAPLAN, M.D. AND A. L. UMANSKY, M.D.
New York, New York

THE cumulative and critically appraised experience in the past ten years with herniated intervertebral disc lesions as the most common cause of low back pain has led to progressive refinements of diagnostic technic. Although no individual procedure in our armamentarium is pathognomonic for disc lesions, correlative patterns drawn from the anamnesis, physical examination and laboratory findings usually lead to an accurate diagnosis. The most recent and almost completely objective criteria have been established through the adjuvant use of pantopaque myelography.

The differentiation between far advanced cauda equina neoplasms and herniated discs rarely poses a problem. Indeed it is believed by some that even early cases may be differentiated on a purely clinical basis. On a few occasions, however, the clinical findings, especially in cases with a history of trauma, have disclosed cauda equina tumors masquerading as herniated intervertebral discs. More recently Love[1] and others have published evidence that cases of cauda equina neoplasm may readily simulate a disc syndrome. That the reverse may occur is apparently less commonly appreciated.

It is therefore of interest to note that Kennedy, Hyde and Kaufman[2] have reported three cases, each showing the clinical picture of a spinal cord neoplasm which at operation proved to be a herniated disc. These patients showed paralysis as well as anesthesia of the lower extremities, urinary incontinence, transient priapism and other signs most often found in advance stages of neoplasms of the cauda equina. In two of the patients, however, the myelograms were not suggestive of cauda equina neoplasm, and in the third there was a complete subarachnoid block although the spinal fluid protein was only 86 mg. per cent.

Love[1] believes that if the total protein of the spinal fluid is over 100 mg. per cent it favors the diagnosis of neoplasm rather than a herniated disc. Similarly, one of us[3–5] believed that the early diagnosis of cauda equina neoplasm was almost entirely a laboratory procedure and that the finding of xanthochromia in protruded discs is so rare that the question of neoplasm should be raised immediately. Although these statements may be generally true, one of our patients is an outstanding exception to this rule. We have come to agree with Falconer, McGeorge and Begg[6] that no figure of the spinal fluid protein can be taken as the line of demarcation for the differential diagnosis. They, too, have observed values much higher than 100 mg. per cent in cases of proved intervertebral disc without complete subarachnoid block. On the other hand, in one of their patients with cauda equina neoplasm the total protein was only 80 mg. per cent.

It is therefore our belief that pantopaque myelography should be used routinely in patients with persistent and recurrent low back pain with and without sciatic radiation. We strongly advocate this diagnostic procedure for the following reasons: (1) With very few exceptions myelography confirms or rules out the clinical impression of a herniated intervertebral disc. (2) Myelography demonstrates the level as well as the side of the protruded disc. (3) Myelography will show the approximate size of the disc protrusion and its relationship to the theca and extrathecal nerve roots. (4) Only myelography will demon-

* From the Neurosurgical and Orthopedic Services, Hospital for Joint Diseases, New York, N. Y.

strate multiple disc protrusions when present. (5) Myelographic defects have recently been found on the side contralateral to the signs and symptoms[7] and bilateral exploration at the involved interspace corroborated the myelographic studies and were negative on the opposite side. (6) Finally, myelograms will help differentiate cauda equina neoplasms from herniated discs and other lesions simulating the disc syndrome.

In short, myelography not only helps in the early diagnosis of surgical lesions of the spinal cord but also is an excellent guide in the planning of the operation. That myelography, although high in its percentage of accurate diagnoses, may at times be confusing and even be misleading is familiar to us all. For some time a complete or almost complete arrest of the contrast medium in the lumbar region has been accepted as positive proof in favor of a neoplasm of the cauda equina regardless of the clinical findings. However, our recent experiences have shown that complete arrest of the pantopaque column may be due to obstruction by a giant herniated disc.

In our series of over 100 verified herniated intervertebral discs we have found ten cases which have shown complete pantopaque block. These patients were strongly suspected of having cauda equina neoplasms. We are presenting the following case histories and comments to emphasize some diagnostic pitfalls and to illustrate some differential points in myelography of herniated intervertebral discs and cauda equina neoplasms.

CASE REPORTS

CASE 1. M. D., a thirty-four year old male was admitted to the hospital on November 8, 1947, complaining of severe low back pain and inability to walk straight. In 1928 this patient fractured his left elbow, and in 1942 he injured the "hamstrings" of his left leg which incapacitated him for several months. On August 24, 1947, while raising a 24-pound weight he felt a sudden pull in the right lumbar region. The next day the lower back became stiff and the patient was unable to bend over to tie his shoes. Two weeks later pain was noted down the medial and posterior aspect of the right thigh to the calf. Sneezing and coughing greatly intensified the pain. The patient tried but was unable to stay at his job. Three osteopathic manipulations brought no relief. A Knight spinal brace also failed to bring the desired relief. In the meantime the patient noted pain in both buttocks and was unable to sit for any length of time. For two weeks the pain in the right leg subsided, but then the patient noted pain radiating down the left leg. This was also intensified by coughing and sneezing. For a fortnight tingling and numbness was felt in the left thigh and calf. There was marked diminution in libido for two months before admission but no urinary symptoms.

FIG. 1. Case 1. Complete pantopaque arrest at third lumbar interspace.

Examination showed a well developed young man in great distress, hardly able to stand, walk or sit down. Every movement was done guardedly. There was marked spasm of the lumbar muscles, more so on the right, but no diminution in lumbar curve. Forward flexion of the spine was limited to 20 degrees, left lateral flexion was painful and hyperextension was very painful. Straight leg raising was limited on both sides, and Lasègue's sign was bilaterally positive. The Naffziger test was positive with radiation of pain down the right leg. Tenderness was acute to either side of L_4 and L_5 spines. The knee and ankle jerks were hyperactive. There were no sensory disturbances and no pathologic toe signs. The spinal fluid was clear and colorless, with a total protein of 66 mg. per cent. Jugular compression suggested complete subarachnoid block.

X-rays of the lumbar spine showed a narrowing of the lumbosacral joint. Myelograms showed complete arrest at the third lumbar interspace. (Fig. 1.)

FIG. 2. Case II. Spot film showing complete block at third lumbar vertebra.

On November 17, 1947, a complete laminectomy at L2 and L3 disclosed a normal-appearing dura with a moderate amount of extradural fat. When the dura was retracted on the left, a large herniating disc came into view and was found to extend to the midline. After incising the posterior longitudinal capsule, the disc was removed with a curet because it was so adherent to the adjacent structures. To rule out the possibility of a cauda equina neoplasm the dura was opened for ½ cm. and a No. 14 catheter was directed in both directions; however, no obstruction or resistance was encountered. The wound was then closed in layers but no spinal fusion was done.

Except for some difficulty in voiding and moderate abdominal distention for the first few days the postoperative course was uneventful. The patient was discharged symptom-free from the hospital December 5, 1947, eighteen days postoperatively. The only abnormal findings were sluggish ankle jerks. Since then the patient has returned to work and both ankle jerks have become active.

Comment. This patient had bilateral symptoms first in both buttocks and then alternating leg pain. Limitation in straight leg raising and Lasègue's sign were present on both sides and there was no inequality of the patellar or achilles reflexes. Manometric test showed complete subarachnoid block and myelograms confirmed complete pantopaque arrest at the third lumbar interspace, yet the total protein was only 66 mg. per cent. In spite of the findings of extradural fat and a large adherent disc, the dura was nevertheless opened and catheter exploration in both directions proved beyond doubt the absence of a cauda equina neoplasm.

CASE II. M. L., a forty-nine year old male, was first admitted to the hospital complaining of low back pain. In May, 1942, while lifting a crate weighing 100 pounds he felt a sudden pain and crick across the lower back. Several months later the pain began to radiate down the posterior aspect of the right leg along the distribution of the sciatic nerve. The pain was intensified by coughing, sneezing and straining at stool. The only abnormal findings were a tilt of the trunk to the right and diminution of the right knee and ankle jerks. After manipulation under general anesthesia the patient was placed in a plaster cast. The tilt gradually disappeared and on July 25, 1942, he was discharged symptom-free.

From October, 1942, to March, 1943, this man was in the U.S. Army and his only complaint was some weakness of the back. For the next five years he had numerous recurrent attacks of low back pain with sciatic radiation down the left leg. On February 5, 1948, while stooping over to pick up a package he was seized with a sudden severe pain across the lower back which radiated down the left leg. The pain was so severe he could hardly bend or stand. Any activity intensified the pain. The left leg became numb and there was tingling in the toes of the left foot. There were no urinary symptoms.

Examination on February 10, 1948, showed a moderately obese, plethoric man whose knees would buckle when he tried to stand. There was obliteration of the lumbar curve and a marked tilt of the torso to the left. The overlying lumbar muscles were in great spasm, more marked on the left. Hyperextension of the spine and left lateral flexion were limited and extremely painful. Straight leg raising on the left was limited to 140 degrees and Lasègue's sign was positive on the left. The right knee jerk and left ankle jerk were absent. Under observation weakness of both legs progressed.

Manometric test showed complete subarachnoid block, with xanthochronic fluid which clotted within five minutes (Froin syndrome). The total protein was 2,200 mg. per cent. Pantopaque studies showed a complete block at the third lumbar vertebra. (Fig. 2.) Following this procedure the patient

began to have urinary retention and increasing weakness of both legs.

Laminectomy was performed February 24, 1948, and at the upper level of the third lumbar vertebra on the left a large sequestrated disc 2½ by 1 cm. was removed in one piece. This was followed with spinal fusion with an iliac graft.

The patient regained power in both legs shortly after the operation and the urinary difficulties disappeared in a week. On April 17, 1948, he was discharged symptom-free and walking about comfortably in a plaster jacket.

Comment. The differential diagnosis between a herniated disc and cauda equina neoplasm was most difficult in this patient. The recurrent attacks of low back pain with sciatic radiation over a six-year period was in favor of disc herniation. On the other hand, the paresis of both extremities, complete subarachnoid block, xanthochromic fluid with Froin syndrome, extraordinary elevation of the total protein of the spinal fluid to 2,200 mg. per cent and the block by pantopaque pointed almost conclusively to neoplasm of the cauda equina. The operation was therefore planned for complete laminectomy. To attempt removal of such an enormous disc through a limited interlaminar exposure would have resulted in more harm than good.

Case III. F. L., a forty-four year old male, was admitted to the hospital May 4, 1948, complaining of severe low back pain radiating down the left leg. Nine months before admission while lifting a heavy dresser he felt a sudden, severe, pain across the lower back which made walking, sitting or standing very difficult, and he was forced to bed. Gradually during the next six months the pain subsided and slowly the patient was able to return to work. Nevertheless he was troubled with intermittent low back pain which was intensified by walking or working. Three months before admission the pain began to radiate from the left lumbosacral region toward the anterosuperior iliac spine and then posteriorly down the back of the left leg to the medial malleolus. Coughing and sneezing intensified the pain. Shortly thereafter he began to walk with anterior flexion of the lumbar spine and a list of the torso to the right. He was unable to straighten. With these persistent disabilities he was admitted to the hospital.

Shortly after admission the patient's pain seemed to subside in severity and was no longer accentuated by coughing or sneezing. Strangely enough he obtained relief by sitting and sleeping in a flexed position. A series of physiotherapy treatments were without benefit. There were no sensory or sphincter disturbances.

Examination showed a well developed man who walked with a limp of the right leg and a marked tilt of the torso forward and to the right. The lumbar curve was obliterated and there was pronounced overlying muscle spasm with curvature in the dorsolumbar region. Localized tenderness was elicited over the lower lumbar spine, particularly over the lumbosacral joint. Forward bending caused the left knee to buckle. At times he could bend to a distance of 9 inches from the floor with both knees in extension. At the extremes of motion he felt pain referred to the left posterosuperior iliac spine. Hyperextension of the spine or lateral flexion in either direction was extremely painful. In the sitting position rotation of the spine was free but painful. However, there was no restriction of forward bending and curves of the spine showed no deviation from the normal pattern. The straight leg-raising test was 105 degrees on the right and 130 degrees on the left. Hyperextension of the left leg was painful and restricted but not so on the right. The Naffziger test was positive. The left thigh showed atrophy of ½ inch and the left calf showed atrophy of ¼ inch. The knee and ankle jerks were active and equal.

Roentgenograms of the spine showed deviations of the lumbar spine to the right at the level of the third and fourth vertebrae with osteoarthritic changes of the adjacent joint margins and some lipping and slight osteophyte formation. The fifth lumbar vertebra was sacralized on the left. The rudimentary articulations between the transverse processes and the ala of the sacrum were very striking. The apophyseal joints between the fourth and fifth lumbar vertebrae on the right were narrow and there seemed to be some overriding of the facets at this level. Manometric tests showed no evidence of subarachnoid block. The fluid was clear and colorless and the total protein was 58 mg. per cent. Myelography (Fig. 3) revealed a complete block at the level of the third and fourth lumbar vertebrae

FIG. 3. Case III. Spot film showing complete block and "cap" formation at lower border of third lumbar vertebra.

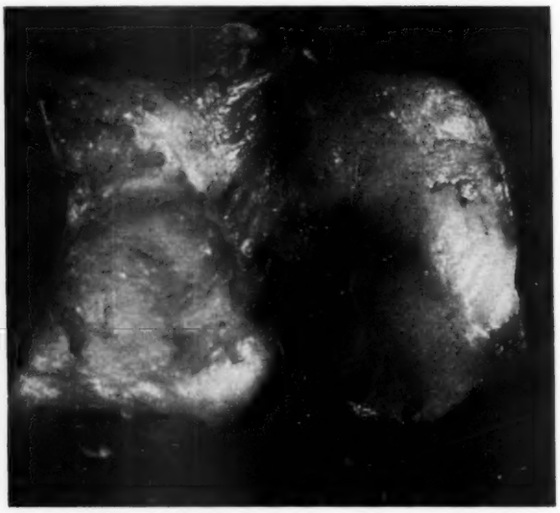


FIG. 4. Case III. Sequestrated intervertebral disc; central defect due to absorption of nucleus pulposus.

with feathering and blunting of the lower portion of the pantopaque column and "cap formation."

Laminectomy on June 1, 1948, disclosed a large, protruding, herniated intervertebral disc measuring 2 by 1 cm. (Fig. 4) on the left side between the third and fourth lumbar vertebrae. Following removal of the extruded disc spine fusion was carried out with an iliac H graft. The postoperative course was smooth and uneventful. On the twenty-eighth postoperative day the patient was discharged in a plaster cast free of any complaints.

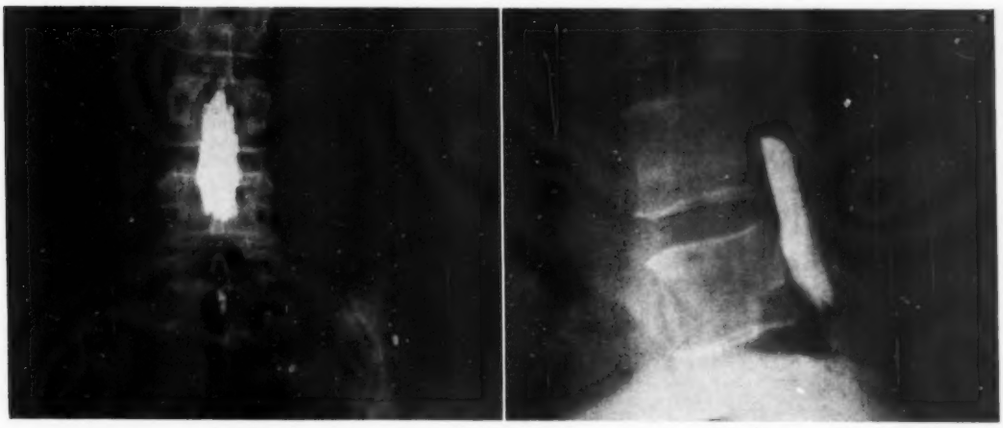
Comment. Although this patient presented the clinical story of unilateral sciatic syndrome, he gave the story of relief of pain by sitting and sleeping in a flexed position which is more often elicited in patients with neoplasms of the cauda equina. It is also interesting to note that in spite of no subarachnoid block by manometric test there was block and "cap" formation by myelography.

CASE IV. M. L., a forty-eight year old female, was admitted to the hospital on June 14, 1948, complaining of low back pain radiating down both legs. It may be of some significance that fourteen years previously this patient fell and fractured her left arm. Otherwise the past history was non-contributory. About one and a half years before admission the patient first began to experience low back pain radiating down the posterior aspect of both thighs and calves. After resting one month in bed she became symptom free. A year later while the patient was bending over to pick up a heavy object the pain across the lower back recurred with great intensity. This time, however, it radiated only down the posterior aspect of the left leg to the instep of the left foot. Straining, standing or walking for short distances was very painful. Osteopathic manipulations increased the pain. Three months before admission the pain began to radiate down the posterior aspect of the right thigh and calf. X-ray studies of the lumbar spine were negative. From time to time there were tingling and "electric shock" sensations over the outer aspect of the left foot. Coughing and sneezing did not intensify the symptoms. There were no urinary disturbances.

Examination showed a moderately obese woman in great distress, hardly able to move about in bed. In the erect position there was loss of the lumbar curve with spasm of the lumbar muscles. Spinal motion was not particularly restricted in any one direction. The knee jerks were sluggish and both ankle jerks were absent. There was an indefinite area of hypalgesia on the outer aspect of the left foot.

The spinal fluid was clear and colorless with an initial pressure of 160 mm. of water. There was no evidence of subarachnoid block. The total protein was 59 mg. per cent.

X-rays of the lumbosacral region failed to show any abnormality. Myelogram disclosed the opaque column arrested at the lower border of L4 with a suggestive "cap" formation. (Figs. 5 and 6.)



5 6

FIG. 5. Case IV. Myelogram; anteroposterior view showing almost complete block at the fourth lumbar vertebra.
FIG. 6. Same case; myelogram with suggestive "cap" at lower border of fourth lumbar vertebra.

Laminectomy was performed on June 18, 1948; and as the dura opposite the fourth interspace on the right was retracted, a large, extruding intervertebral disc extending across the midline was readily identified. This giant size disc was quite adherent to the surrounding structures and had to be removed in three pieces. (Fig. 7.) This was followed with spinal fusion using an H graft.

The postoperative course was smooth except for some complaint of numbness over the buttocks. At the time of discharge on August 12, 1948, the patient was symptom-free but the ankle jerks were still absent.

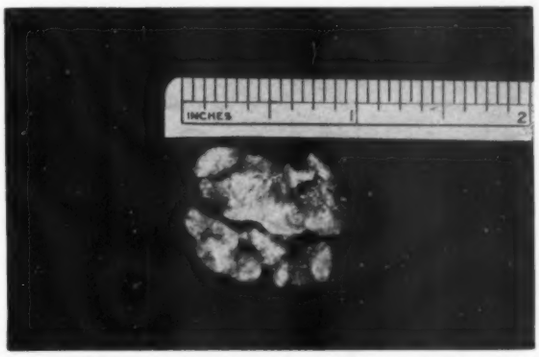


FIG. 7. Case IV. Three portions of adherent giant disc.

Comment. The bilateral sciatic syndrome, absent ankle jerks and "cap" deformity by myelography influenced us in doing a complete laminectomy for a neoplasm of the cauda equina. Against this diagnosis was the absence of subarachnoid block and the total protein of 59 mg. per cent. In this patient complete laminectomy was justifiable because the giant disc could have been safely removed only through such a generous exposure.

CASE V. H. H., a thirty-seven year old female, entered the hospital on August 20, 1948, with the chief complaint of pain in the right buttock and calf. In November, 1947, without obvious cause pain suddenly developed in her right calf; after several days the pain completely disappeared. In February, 1948, without any obvious reason the pain recurred in the right buttock and then radiated down the posterior of the right leg to the calf. At this time a marked tilt of the torso to the left also developed. Physiotherapeutic treatments gave only slight relief. At times she also had slight pain across the lower back. The pain in the right leg was intensified by coughing and sneezing and during inclement weather. Relief of pain was obtained by lying down or sitting.

Examination showed a well developed and slender woman with a marked tilt of the torso to the left. The lumbar curve was completely obliterated and there was marked spasm of the erector spinae muscles on the right, with marked tenderness of the right sacroiliac joint. Forward flexion of the spine was limited to 11 inches from the floor and hyperextension was completely restricted and acutely painful. Lateral flexion of the trunk was painful and restricted to the right. Rotation of the trunk to the right produced pain in the right calf and ankle. There was no spinal tenderness. Straight leg raising on the right was markedly restricted but comparatively free on the left. The right thigh showed atrophy of ¼ inch. Over the

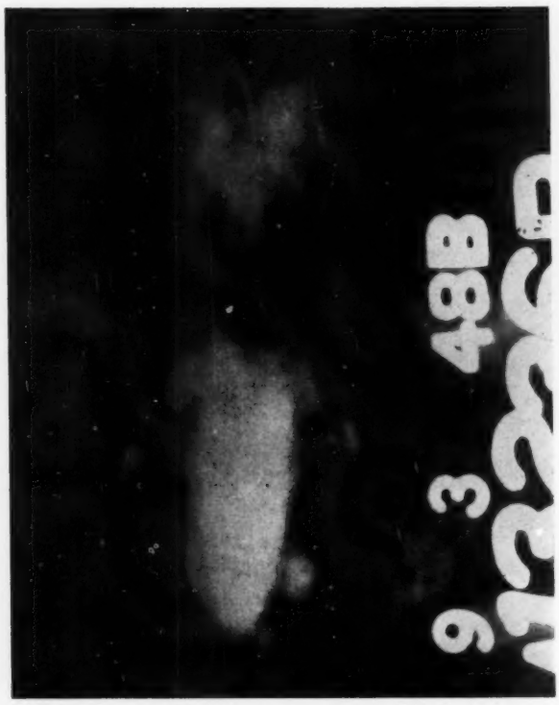


FIG. 8. Case v. Transient pantopaque block with central defect at fourth lumbar interspace.

outer aspect of the right foot and calf there was an area of definite hypesthesia. The knee and ankle jerks were active and equal.

Roentgenography of the lower spine showed partial sacralization of the fifth lumbar vertebra. The spinal fluid was clear and colorless, with no evidence of subarachnoid block. Myelography (Fig. 8) at first revealed a complete block between L4 and L5 but after tilting the table in the Trendelenburg position for thirty minutes the contrast media was visualized above the block. However, the central defect persisted.

Laminectomy was performed on September 14, 1948, and a giant disc measuring 4 by 2½ cm. (Fig. 9) was removed from the interspace between L4 and L5 on the right. This was followed with spinal fusion with an iliac H graft.

The patient's postoperative course was uneventful and on October 13, 1948, she was discharged from the hospital asymptomatic and in a plaster jacket.

Comment. Again we had the problem of normal dynamics by manometric test and a transient block with pantopaque myelography. Clinically, the findings favored a herniated intervertebral disc but the operative plan

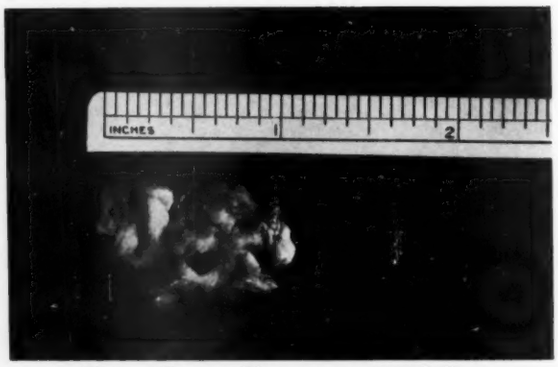
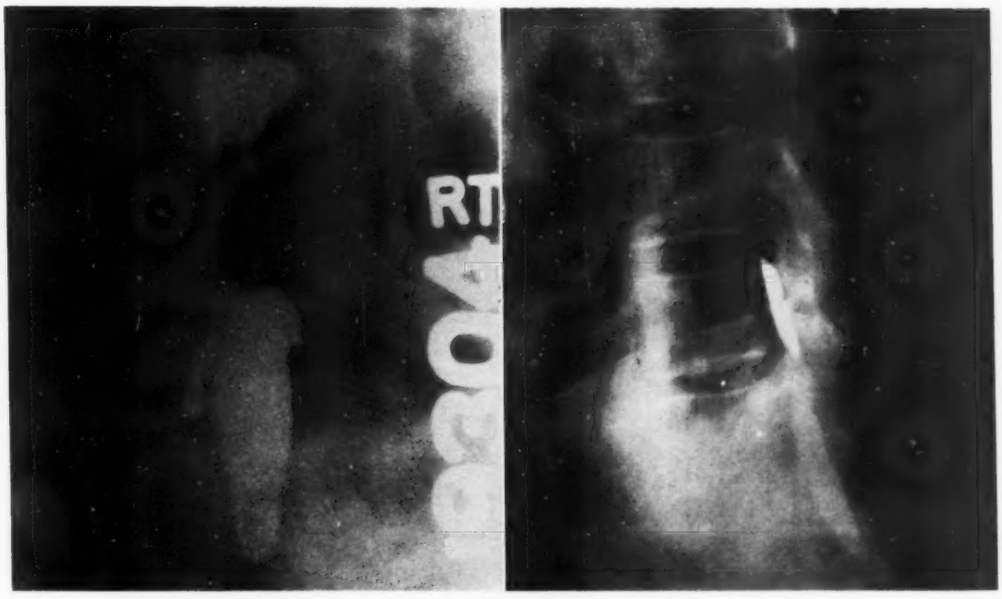


FIG. 9. Case v. Giant sequestrated disc.

allowed for complete laminectomy in the event we encountered a spinal cord neoplasm.

CASE VI. On December 14, 1948, R. S., a fifty-one year old female, was admitted to the hospital complaining of pain in the right buttock radiating down the right leg to the ankle. During the summer of 1941 she noted pain in the left hip and was admitted to the hospital where x-rays showed an osteoid osteoma in the neck of the left femur. At this time she also complained of low back pain. With rest, physiotherapy and novocain injections the pain across the lower back subsided and the patient was discharged from the hospital greatly improved. Nevertheless, she was always aware of a rather weakened back and for two years walked with great caution. Two years before admission the pain down the right leg returned, lasted for about two months and disappeared. The patient was relatively well until eight months before this admission when the pain returned to the right hip and buttock and radiated down the posterior aspect of the right leg to the toes. At times the entire right leg felt as if it were crushed. Various forms of therapy including novocaine injections brought no relief. For four weeks she had been bedridden, hardly able to walk or to move about in bed. Coughing, sneezing or even the barest pressure on the right leg greatly intensified the pain. There were no subjective sensory disturbances and no urinary or rectal difficulty.

Examination showed a well developed, middle-aged woman lying comfortably in bed but moving about very cautiously. She had to be helped out of bed and with assistance could take a few steps. When standing she held the right knee flexed. There was loss of the lumbar curve with considerable spasm of



10 11

FIG. 10. Case VI. "Spot" film showing transient pantopaque block.
FIG. 11. Same case; lateral view showing defect at fourth lumbar interspace.

the lumbar muscles. The most acute focus of tenderness was to the right of L4 and L5 spines. There was also tenderness over the right sciatic notch. Straight leg raising on the right was markedly limited and painful; straight leg raising on the left also caused pain in the right hip. Flexion of the right hip with the knee flexed was very painful and Lasègue's sign was positive on both sides but more marked on the right. The Naffziger test was negative. The knee and ankle jerks were absent but there was no Babinski sign or ankle clonus.

X-ray of the lumbosacral spine showed a narrowing of L4 and L5 interspace. The spinal fluid dynamics were normal and the total protein was 35 mg. per cent. Myelograms using 3 cc. of pantopaque revealed a transient block with an irregular bilateral defect at L4 and L5. (Figs. 10 and 11.) A cauda equina neoplasm as well as a giant herniated disc was suspected.

On January 5, 1949, laminectomy was performed. When the fourth lumbar interspace on the right was exposed, the nerve root was thin and frayed. As the dura and nerve root were retracted to the left, a large disc protrusion could readily be seen extending to the midline and was removed in one piece. (Fig. 12.) It measured 3½ by 2 cm. This was followed with spinal fusion with an iliac graft.

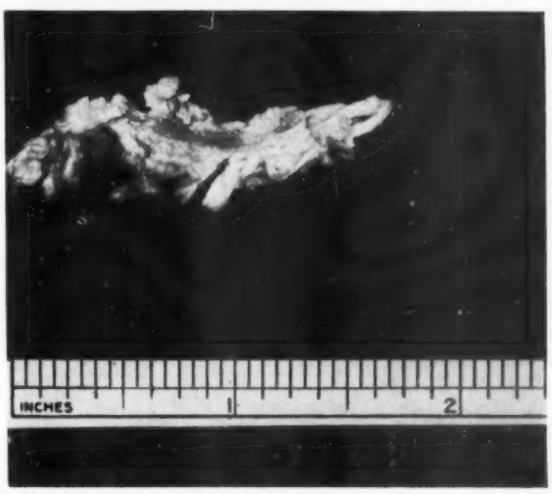


FIG. 12. Case VI. Central giant disc sequestrated in one piece.

The patient voided spontaneously on the day following operation. The pain disappeared completely and at the time of discharge the patient still felt some numbness of the right foot. The knee jerks and ankle jerks were still absent.

Comment. The only clue of bilateral involvement was the absent knee and ankle jerks. However, the total protein was only 33 mg. per cent. The irregular bilateral pantopaque defect was only suggestive of a neoplasm and the operation was so planned as to allow

13 14

FIG. 13. Case VII. Myelogram showing almost complete block at fourth lumbar interspace with major defect on the right.
FIG. 14. Same case; "spot" film showing narrowing of fourth lumbar interspace with giant defect just below this level.

for the removal of a giant disc or be converted for the removal of a neoplasm.

CASE VII. J. W., a thirty-five year old female, was admitted to the hospital on April 4, 1949, because of low back pain and increasing paralysis of both legs. For some years this patient had had monthly epileptic seizures on the basis of congenital lues. These convulsions were almost completely controlled by medication.

During her childhood the patient was an acrobatic dancer and at fourteen years of age she fell, twisted her back and had to remain in bed for two weeks. She recovered completely and remained well until three years before admission when she was seized with severe pain in the right leg. Shortly thereafter the right leg became weaker. In addition she noted a foot drop on the right and some difficulty starting urination. For eight or nine months this patient was seriously disabled but then all her symptoms gradually cleared up except for some residual low back pain. She remained relatively well until one year prior to admission when the pain recurred. This time there was pain in the left hip which radiated down the posterior aspect of the left leg to the ankle and toes. The pain gradually increased in severity, became fairly constant and was intensified by sneezing, coughing or even lying down. While standing the left leg was held flexed for relief of pain. In addition there was persistent tingling in the toes of the left foot. Walking became gradually more difficult and the patient used a cane for support. For several months before admission she was totally incapacitated. There was no urinary symptoms.

Examination showed a well developed, spirited young woman who needed support to get in and out of bed. She walked with great effort using a cane. The gait was slow and the trunk was bent forward and to the right. The lumbar curve was completely lost and one could see the marked spasm of the lumbar muscles more strikingly on the left. The Naffziger test was positive. There was exquisite focal tenderness to the left of L_4 and L_5 spines. Straight leg raising was limited on the left and Lasègue's sign was positive on the same side. The knee jerks were active and equal but the ankle jerks were very sluggish and almost absent on the left. There was no sensory deficit.

On April 5, 1949, manometric test showed clear, colorless spinal fluid with a slow rise and fall upon jugular compression. The fluid showed no cells, negative Wassermann reaction and a total protein of 112 mg. per cent. Pantopaque, 3 cc., was injected and showed almost complete block at the level of L4 and L5 interspace. A small irregular trickling of pantopaque passed down the left side to settle in the dural cul-de-sac. (Figs. 13 and 14.) A spinal cord neoplasm or a giant herniated disc was suspected.

On April 11, 1949, the spines and laminas from L3 to S1 were exposed. The ligamentum flavum between L4 and L5 on the left was removed and only a slight bulge of the dura and nerve root could be seen at this level. A complete laminectomy was performed of L4 with the removal of small portions of the laminas of L3 and L5. There was a moderate amount of extradural fat but no evidence of neoplasm. As the dura on the right side of the fourth lumbar interspace was retracted, the nerve root could be readily visualized. It was thin, frayed out and stretched tensely over a large, adherent, anteriorly placed mass. In trying to obtain a better view of this protruding mass a small tear inadvertently occurred in the dura, resulting in the free escape of spinal fluid. This fortunately facilitated the exposure and a large sequestrated disc measuring 3 by 2 cm. (Fig. 15) was extracted with ease. With a curet smaller pieces of degenerated disc substances were removed. The tear in the dura was sealed over with a stamp of muscle. After satisfactory hemostasis the wound was closed in layers without drainage.

The postoperative course was very gratifying. The patient voided spontaneously on the evening of the operation and on the following day she volunteered the statement that both legs were moving with greater ease. The pain was almost completely gone. From then on she showed very rapid improvement; the wound healed by primary union and within a week she was out of bed. On April 27, 1949, she was discharged from the hospital free of pain and able to walk without assistance. There was no change in the reflexes. Since then the patient has shown steady improvement and has returned to work.

Comment. This patient's trauma twenty-one years earlier undoubtedly bears a causal relationship to the symptoms which followed. It is interesting to note that three years before admission the symptoms first involved the right leg and subsided almost completely after nine months. Curiously enough the recurrence of symptoms two years later involved only the left leg. The myelographic defect favored a spinal cord neoplasm although a giant herniated disc was strongly suspected. The operative exposure was at first directed to the left side, toward the side of presenting symptoms and signs; but when no disc protrusion was found, a bilateral exposure was done and the giant disc protrusion was found on the right side. Here the fifth lumbar root could be seen thinned out, frayed and under considerable tension and yet surprisingly there were no symptoms and no abnormal neurologic findings to suggest such a large disc protrusion on the right side. It is indeed difficult to explain this condition. However, this experience clearly illustrates that if one were to depend only on the clinical picture and omit pantopaque myelography, the left side only might have been explored, and perhaps an additional interspace above or below, but the real pathologic condition on the opposite side would have been overlooked.

FIG. 15. Case VII. Sequestrated intervertebral disc contralateral to side of symptoms.

CASE VIII. R. K., a forty-nine year old male, was admitted to the hospital on July 5,

FIG. 16. Case VIII. Complete pantopaque arrest at L2 and L3.

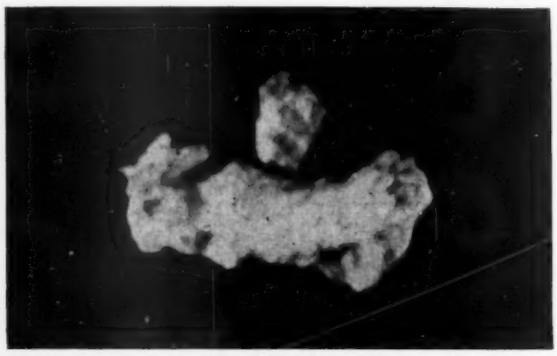


FIG. 17. Case VIII. Giant herniated disc causing acute compression of cauda equina.

1949, because of low back pain and almost complete paralysis of the lower extremities. The past history was irrelevant except for a fall ten years previously resulting in a fracture of the left ankle. For about one year this patient noted some difficulty in erections but otherwise was in relatively good health and drove his taxi daily without discomfort until six weeks before admission to the hospital. About this time he started to complain of persistent low back pain which after a week began to radiate to the left buttock. Shortly thereafter the pain radiated to both buttocks and down the posterior aspect of the thighs to the knees. The pain was not intensified by coughing or straining. In addition to the pain the patient noted increasing weakness of the left leg which gradually limited his driving until he was unable to work. About a fortnight before admission the weakness spread to involve both legs, and four days later the patient was no longer able to stand or get out of bed. At this time he also noted numbness in both buttocks and some tightening of the rectal sphincter. On several occasions he lost rectal control but urinary function was undisturbed.

Examination showed a large, heavy man lying helplessly in bed. There was almost total paralysis of both legs. Only the toes of the right foot showed any motion. Any twisting of the trunk greatly intensified the back pain. There was generalized atrophy of both lower extremities, more marked on the left. To the left of the fifth lumbar spine there was definite focal tenderness. The only sensory deficit was a hypalgesia over the left buttock involving the skin segments S3 and S4. The Naffziger test was negative. The cremasteric and upper abdominal responses were active and equal but the lower abdominal reflexes were absent. The knee and ankle jerks could not be elicited. The suspected diagnosis was either a spinal cord neoplasm (primary or metastatic) or a giant herniated disc.

On the day of admission the manometric test showed clear, colorless spinal fluid with no evidence of subarachnoid block. There were only two cells. The total protein was 85 mg. per cent, the Wassermann test was negative and colloidal gold was 2232222321. Pantopaque, 3 cc., was injected and was completely arrested at L2 and L3 interspace. (Fig. 16.)

On July 5, 1949, the spines and laminas of L1, L2 and L3 were exposed and a total laminectomy was performed of L2. As the laminas and ligamentum flavum were removed, a whitish mass presented itself on the left dorsolateral surface of the dura. Upon further exposure it became clear that we were dealing with a giant herniated intervertebral disc, the largest in my experience, which had completely prolapsed and managed to extrude itself laterally and dorsally causing acute compression of the roots of the cauda equina. For all practical purposes it acted like a neoplasm. This disc (Fig. 17) was easily removed and measured 3 by 5 cm. The cavity was curretted but there were no remaining fragments of degenerated disc substance. After careful hemostasis the wound was closed in layers. The patient was given a transfusion of 500 cc. of blood.

The postoperative course was stormy and prolonged. On the day after operative the patient voided spontaneously and seemed to

have more natural feelings in both legs. Rectal control was poor and enemas failed to bring the desired results. On July 13, 1949, a massive fecal impaction was discovered which was corrected by appropriate measures. The wound healed by primary union. Nevertheless, the patient had mild fever and complained of coldness in the left leg. On July 17, 1949, his temperature rose to 101°F. and he complained of pain in the left chest. Respirations were rapid and labored and there were signs of a friction rub in the left axillary line. On July 20, 1949, a portable film of the chest showed a pulmonary infarct in the left lower lobe. Within the next few days, the pain subsided and the patient seemed somewhat improved. However, on July 23, 1949, pain developed in the right chest with similar evidence of another pulmonary embolus. The patient was placed in an oxygen tent and given dicumarol® for several days. By July 27th his respirations were normal, the chest pain had completely disappeared and he was no longer in need of an oxygen tent. In the meantime power in the right leg improved rapidly but there was rather slow improvement in function of the left leg. By August 2nd the patient was able to sit on the edge of the bed and had regained considerable power in both legs. Rectal sphincter control was almost normal. Within the next fortnight there was sufficient improvement so that he was able to stand with the assistance of a walker and take several steps. On August 28, 1949, the date of his discharge, he was able to walk several lengths of the ward with the aid of a walker. The left leg was still considerably weaker than the right. He was free of pain, sensation had returned to normal and there were no further sphincter disturbances. To date this man is free of pain and drives his taxi full time.

Comment. Although there is no definite trauma in this patient's history, the bouncing up and down during the daily activity of a taxi driver might easily be sufficient cause for disc herniation. This has been previously reported by Love in a series of motorcycle drivers. The disturbance in libido for over a year can readily be explained by the level at which the lesion was found. The operative findings are rather unusual in that the prolapsed disc encircled the dura as far as its posterior aspect. It is surprising that the sensory loss was comparatively slight. This patient's paralysis was looked upon as an acute compression of the roots of the cauda equina, and therefore he was treated as a surgical emergency. It may well be that the fecal impaction and the paralysis of both legs caused sufficient venous stasis in the lower extremities to be responsible for the pulmonary emboli.

Case IX. M. B., a forty-seven year old male, was admitted to the hospital on August 25, 1949, complaining of pain and weakness of both legs. Except for "nervous" stomach trouble for the past twenty years the patient had had no serious illness and no history of trauma.

About seven years before admission the patient noted sharp pain across the lower spine which was sufficiently severe so that he could not straighten up. After two weeks of bed rest he was well again and remained so for two years. Shortly thereafter while lifting a heavy object he experienced a sharp pain across the lumbar region which radiated down the left leg. Within a few days the symptoms subsided and the patient again remained well for another year. In 1948 while bending over a wash basin he had a coughing spell and immediately noted a recurrence of the old back pain. The pain continued for about two weeks and during this period his entire trunk seemed out of shape. The symptoms subsided gradually; he straightened up and then returned to work.

Five weeks before admission while digging in a garden the patient suddenly noted a recurrence of pain across the lower lumbar region accompanied with epigastric distress. The back pain gradually increased in severity and the patient was confined to bed for a week. Upon getting up the pain became very intense radiating to the left hip and along the inner aspect of the left leg. Walking or any activity intensified the pain. Even sitting caused considerable discomfort. Shortly thereafter the pain began to radiate down both legs and walking became increasingly difficult. He was admitted to a nearby hospital for observation. X-ray studies of the spine were negative. Because the legs were becoming steadily weaker, a lumbar puncture was performed and this showed subarachnoid block at L3 and L4 interspace but no block above this level. Following the lumbar puncture paresis of the legs advanced rapidly and movement of the

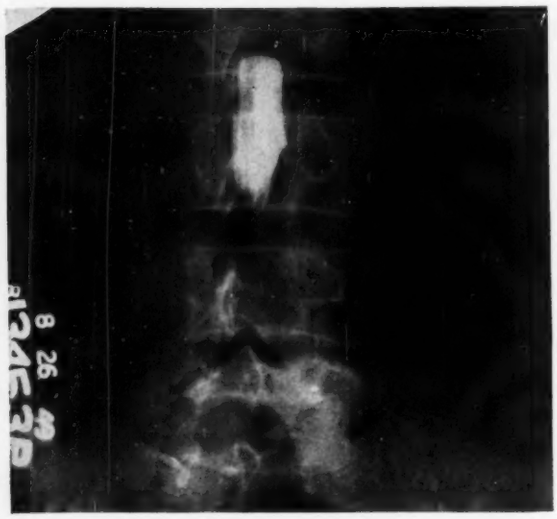


FIG. 18. Case IX. Complete pantopaque arrest at L3 and L4.

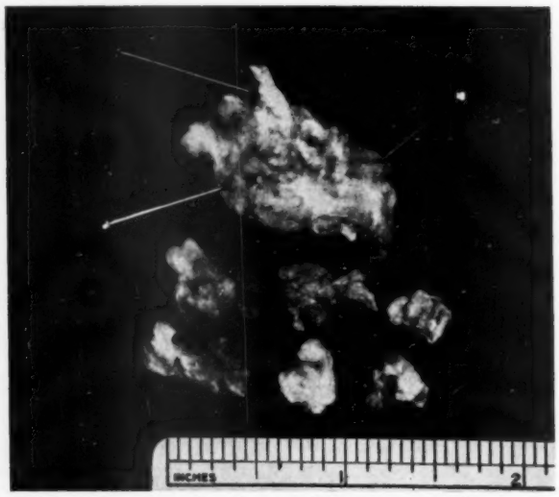


FIG. 19. Case IX. Specimen of degenerated disc cartilage.

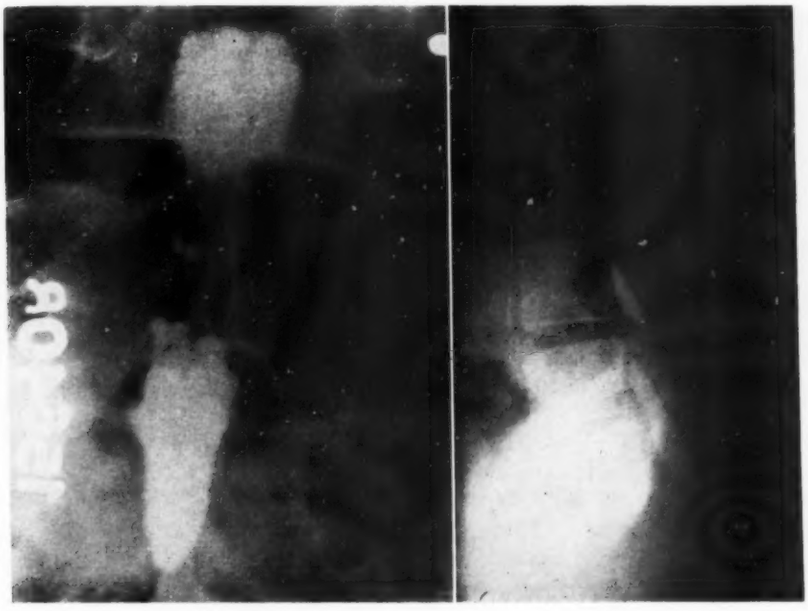
ankles and toes soon disappeared. The calves showed progressive atrophy. The patient also noted numbness in the soles of both feet. There were no urinary symptoms, but for four weeks before admission this patient was unable to have any erections.

Examination showed a middle-aged, gray-haired man resting comfortable in bed, who fully realized the seriousness of his condition. There was marked generalized atrophy of the legs, more so in the calves. The patient could barely raise either leg off the bed, the paresis being greater on the right. There was bilateral foot drop and no movement of the toes. The lumbar curve was diminished and there was marked overlying lumbar spasm. There was acute percussion tenderness to the left of L4 and L5 spines. The Naffziger test was positive and was referred to the testicles. Abdominal and cremasteric reflexes were equal and active on both sides; however, both knee and ankle jerks were absent. The only sensory abnormality was a small area of hyperesthesia on the outer aspect of the left foot. X-rays of the lumbar spine showed no bony deformity or erosion and no narrowing of any lumbar interspace.

On August 26, 1949, manometric test at the second lumbar interspace showed clear, colorless spinal fluid and no subarachnoid block. There were no cells, the total protein was 200 mg. per cent and the Wassermann test was negative. Pantopaque, 3 cc., was injected and was completely arrested at L3 and L4 interspace. (Fig. 18.) A neoplasm of the cauda equina or a giant herniated disc were suspected.

On August 29, 1949, the spines and laminas from L3 to L5 were exposed. While removing the left lamina of the third lumbar vertebra a rounded, grayish white mass presented itself on the dorsolateral aspect of the dura. A complete laminectomy was therefore performed at L3, and portions of L2 and L4 were also removed to obtain a more adequate exposure. The wide exposure demonstrated that a large cartilaginous mass originating anterior and to the left of the dura had encircled the dura laterally and posteriorly. The greater portion of the sequestrated disc was removed in one piece and then smaller more adherent portions of degenerated disc cartilage were removed piecemeal by curet. (Fig. 19.) The dura was then retracted and, contrary to expectations, only a small rent in the posterior longitudinal ligament could be seen. The extradural space above and below this level was explored with a probe to make certain that a second disc was not being overlooked. No resistance was encountered. After careful hemostasis the wound was closed in layers and the patient was given a transfusion of 500 cc. of blood.

The postoperative course was particularly smooth. The patient voided spontaneously on the first day and he stated that both legs seemed to have more life. Power of flexion and extension improved and on the third postoperative day the toes of the left foot began to move. On the following day the big toe of the



20 21

FIG. 20. Case X. Shows temporary obstruction with "veil" defect.
FIG. 21. Same case; lateral view showing posterior displacement by giant herniated disc.

right foot showed evidence of motion. The wound healed by primary union. Power in both legs and muscle tone improved rapidly. On the tenth postoperative day the patient was able to raise both legs off the bed. A fortnight after the operation the patient was out of bed, able to walk several lengths of the ward with a walker and could dorsiflex both feet and move all toes. The knee and ankle jerks were still absent. The patient was discharged on the following day.

Comment. This patient had three episodes of recurrent low back pain following mild trauma, the last one after some spadework in the garden. The rapidly advancing paresis of the lower extremities, the atrophy and the associated disturbances in libido were similar to those noted in Case VIII. The neurologic findings in both of these patients were almost identical. The myelograms showed complete block and were indistinguishable from acute compression of the cauda equina by a neoplasm. The level of the lesions and the massive prolapse of the disc encircling the dura to the posterior aspect were also strikingly similar. The operative findings of only a small rent in the posterior longitudinal ligament may be explained by fibrous healing of this ligament following the complete prolapse of the intervertebral disc.

CASE X. S. K., a twenty-eight year old female, was admitted to the hospital on October 1, 1949, complaining of pain across the lower spine with radiation down the left leg. During her childhood she engaged in considerable acrobatics and during one performance at the age of ten she jackknifed her back and fell over with resulting severe back pain. Since then about once or twice a year she experienced recurrent mild attacks of low back pain, usually lasting about one week and relieved by strapping. In May, 1949, while pulling a heavy trunk she felt an acute pain across the lower spine. This lasted about one week and then began to radiate to the left hip and down the posterior aspect of the left leg to the knee and then the ankle. The pain gradually increased in severity and was intensified by coughing, sneezing, straining, sudden rising or sitting down. About this time she also noted numbness in the big toe of the left foot. For a week during May, 1949, the trunk was tilted to the left.

X-rays of the spine showed a narrowing of the lumbosacral joint. Since July, 1949, the patient had noted some weakness of the left leg and increasing difficulty in walking. At no time was there pain referable to the right leg and there were no urinary symptoms.

Examination showed a young woman who

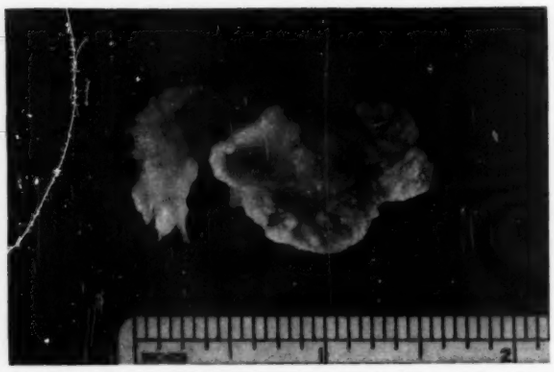


FIG. 22. Case x. Giant sequestrated disc removed at operation.

moved cautiously and who was in considerable distress. She had difficulty in rising from a prone position or turning in bed. There was loss of lumbar curve, with marked spasm of the overlying muscles. The back pain was intensified by forward and right lateral flexion as well as by hyperextension. The hopping test on the left leg was very painful. Straight leg raising on the left was limited to 35 degrees and Lasèque's sign was positive on the left. The only sensory abnormality was hyperesthesia of the left big toe. The knee jerks were sluggish but the ankle jerks were equal and active. There were no pathologic toe signs. Urinalysis was negative as was the Mazzini test. White blood cells were 6,500, polymorphonuclears 54, lymphocytes 40, hemoglobin 13.3 gm. and red blood cells 4,320,000 per cu. mm. The manometric test showed clear, colorless spinal fluid with no evidence of subarachnoid block. The fluid showed no cells, the Kahn test was negative and the total protein was 32 mg. per cent. Pantopaque, 3 cc., was injected and showed a large bilateral defect between the fourth and fifth lumbar vertebrae. (Figs. 20 and 21.)

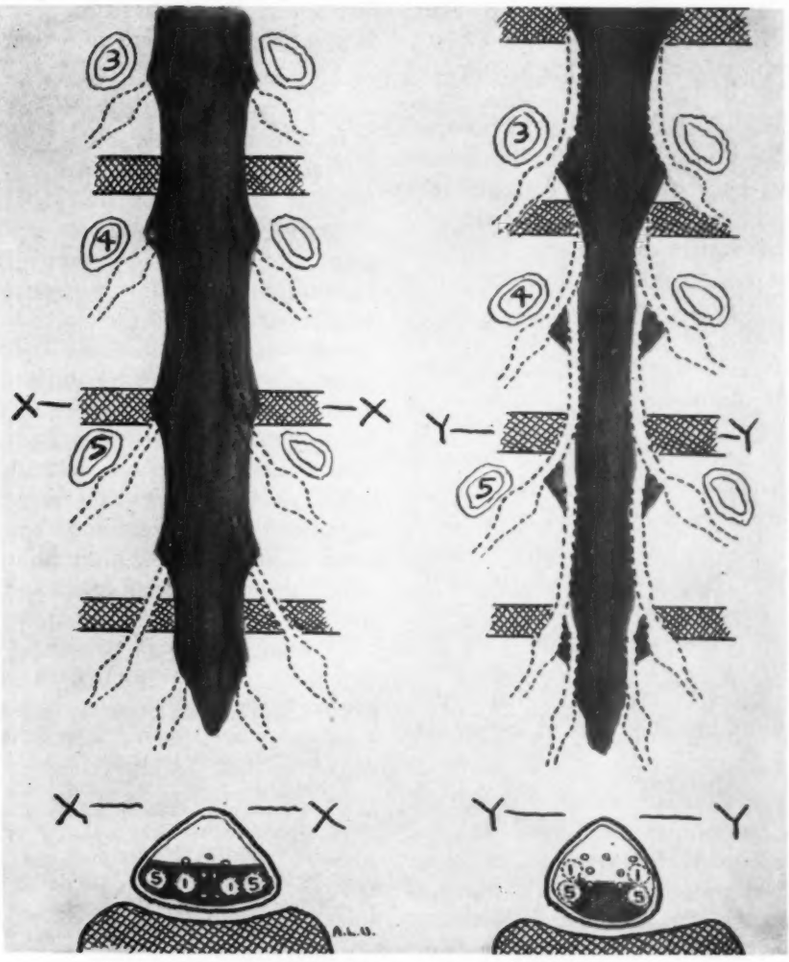
On October 10, 1949, under intratracheal anesthesia the interspace of L4 and L5 was exposed. The ligamentum flavum which was fairly thick was removed, and upon exposing the dura a large protrusion was felt. When portions of the fourth and fifth laminas were removed to obtain a more generous exposure, a giant disc came into view and this was removed in two pieces. It measured 3 by 4 cm. (Fig. 22.) After careful hemostasis the wound was closed in layers without spinal fusion.

Except for some difficulty in voiding during the first forty-eight hours following operation the postoperative course was uneventful. The pain subsided almost immediately after operation, the wound healed by primary union and the patient was allowed out of bed on the seventh postoperative day. On October 20, 1949, three days later, she was discharged.

Comment. In our experience when a young woman engaged in acrobatics or vigorous sports sustains a back injury with a transient period of disability an area of lessened resistance has been established in the posterior longitudinal ligament or the annulus fibrosus or both. Subsequently any sudden severe low back strain, particularly when unexpected which is the time the patient's muscles are not set to meet the increased intraarticular pressure, may readily precipitate a disc protrusion or further disc herniation. This is exactly what happened to this patient. The only bilaterality of signs were the absent knee jerks. The wide and almost complete obstruction to the pantopaque flow was consistent with the findings of a giant disc behaving like a neoplasm of the cauda equina.

REMARKS

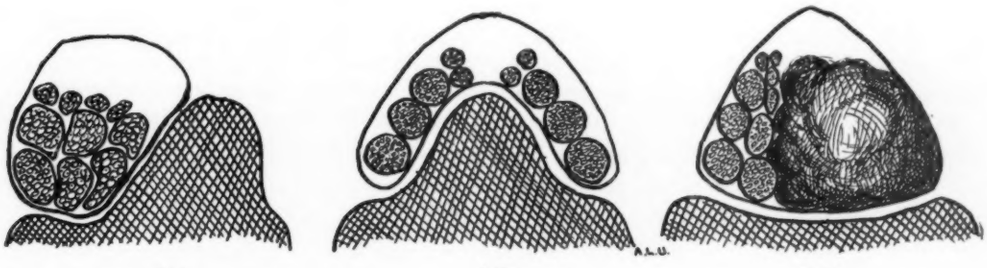
With an understanding of the hydrodynamics of myelography one can readily interpret the defects of disc herniation which simulate cauda equina neoplasms. Begg, Falconer and McGeorge[8] have recently published excellent and detailed descriptions of the physiology and mechanical principles underlying the normal and pathologic changes in pantopaque myelography. The authors differentiate two normal types of thecal configurations which are always symmetrical. (Fig. 23.) One is the cylindrical type with even tubular forms and the other is a ringed type with zones of constriction between the levels which mark the exit of each successive pair of spinal roots. By fluoroscopy the abnormal appearance of the radiopaque column may be only transient but will vary with the size, position and relationship of the disc protrusion to the extrathecal dura and nerve root. For example, a medium-sized disc protrusion may result in a round central defect with the radiopaque thecal column passing to either side and not showing any marginal deformity. Because some of the roots of the cauda equina lie over the summit of the protruding ridge, a "veil" defect is produced as some of the dye



Cross section of theca at level of 4L disc

23A 23B

FIG. 23. Two main types of thecal configuration. A, cylindrical type; B, ringed type.



24A 24B 24C

FIG. 24. Mechanism of complete block with giant herniated discs and cauda equina neoplasm. A, giant disc protrusion (lateral); B, giant disc protrusion (central); C, neoplasm.

fills the spaces between these roots. However, when the herniated disc is of giant proportions, it can readily produce complete block (Fig. 24) although this may be only temporary. It may even result in a typical "cap" formation. If, however, the fluoroscopy examination is prolonged a half hour or longer, some pantopaque will usually trickle by the obstruction, particularly with change of position. Twisting of the spine or coughing may facilitate the passage of the pantopaque beyond the point of complete block. As presented previously[9] the mechanism by which myelographic obstruction of a giant herniated disc simulates a cauda equina neoplasm is due to an almost complete midline invagination of the anterior thecal wall against the roots of the cauda equina, displacing them in a manner to produce complete obstruction to the flow of pantopaque even though this may not be permanent. In our series of ten patients two cases showed complete and persistant obstruction to the flow of pantopaque and the myelographic defect could not be differentiated from the appearance as found in neoplasms of the cauda equina.

SUMMARY

What is most striking about these ten patients with giant herniated discs is that clinically they presented either a history of bilateral or alternating symptoms of the lower extremities or neurologic disturbances involving the deep reflexes on both sides. In only one patient was there any urinary symptoms. The manometric test showed complete subarachnoid block in two patients and the total protein of the spinal fluid varied from 33 to 2,200 mg. per cent. Myelography showed a "cap" formation in two patients. Complete laminectomy was carried out in six patients and it proved to be the wiser surgical approach under the circumstances. In four patients a more limited exposure proved to be just as satisfactory and was determined by the ease with which the disc protrusion could be removed. The size and contour of the myelographic defect in most instances was the best guide to the plan of operation.

CONCLUSION

In the very early stages neoplasms in the region of the cauda equina are unusually difficult to recognize clinically and at times practically impossible to differentiate from giant herniated intervertebral discs. Myelography establishes the presence and position of the pathologic disorder and serves as an excellent guide in the plan of operation. Ten patients are presented with giant herniated intervertebral discs having myelographic defects simulating cauda equina neoplasms. In our experience there are no absolute criteria in differentiating giant herniated intervertebral discs from cauda equina neoplasms and the surgical approach should allow for complete laminectomy if the myelographic defect simulates cauda equina neoplasm.

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ALLERGY AND AN ACUTE CONDITION OF THE ABDOMEN FROM THE SURGEON'S VIEWPOINT

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TODAY allergy is playing an increasing role in our knowledge and treatment of many conditions. It has been estimated that from 3 to 10 per cent of the entire population is allergic to something with sufficient severity to interfere in some way with normal living.[1] A voluminous literature has accumulated. The surgeon has been relatively untouched by this phenomenon since having an allergy does not preclude the individual from suffering from the usual conditions necessitating surgery. It is quite often the case that an acute allergic manifestation is accompanied with pains in the abdomen, vomiting, diarrhea and other symptoms which may suggest the need for surgical intervention. However, generally there are concomitant skin or other manifestations or there is a short history of acute pain following the ingestion of unusual food, suggesting the correct diagnosis. It is also undoubtedly true that most cases in which the diagnosis is missed and operation performed are not reported.

Recent experience with a patient in which allergy was considered the probable cause led us to search the literature in order to determine the appearance of lesions of the bowel due to allergy. We found that the descriptions had been reported in a cursory manner, usually in the form of case reports. These were written under various headings such as Henoch's purpura, angioneurotic edema, Schönlein's purpura, etc. The articles of Walzer and his associates[2–5] in this country and of Kaijser[6,7] in Sweden are outstanding exceptions and will be reported in detail later in this paper.

CASE REPORT

G. D., a twenty-seven year old white Italian male, was admitted to the Binghamton City Hospital (L-10146) on November 26, 1947, at 11:30 P.M., with a chief complaint of intermittent, severe lower abdominal pain of four days' duration. Six hours prior to admission the pain became worse and localized in the right lower quadrant and the patient vomited.

The patient had been in relatively good health until about six months before when he began having occasional vague abdominal pain, usually after eating green peppers or celery. There were also complaints of heartburn and an increasing constipation. He had considered himself in excellent health until two years before when he had a severe cerebral concussion suffered in a jeep accident while he was in the Army. Since then he had had frequent headaches for which in the past half year he was taking bromoseltzer almost daily. Also while in the Army he had had an episode of blood in the stools for which no cause was found.

There were no serious illnesses nor operations. Specifically, there was no history of hay fever, asthma, hives, eczema nor any family history of allergy. There had been no hematemesis, melena, epistaxis, undue bleeding tendency nor arthralgia, except as aforementioned.

On physical examination the patient's temperature was 98°F., pulse 80 and respirations 20. The patient was a well developed, well nourished man complaining of severe lower abdominal pain. Localized rigidity, muscle spasm and rebound tenderness were present in the right lower quadrant. A diagnosis of acute appendicitis was made and the abdomen explored through a transverse incision under spinal anesthesia.

A large amount of crystal-clear fluid was found between the coils of the bowel. There were no signs of acute inflammation. About 1½ feet above the ileocecal junction there was a 6-inch area of ileum that was markedly thickened and larger in diameter than the adjacent bowel and of a bright scarlet red color. There was an apparent infiltration of blood into the bowel wall. The mesentery at the bowel junction was somewhat discolored and moderately thickened, giving it a thin "pancake" feel; however, its usual flexibility was preserved. There were no enlarged lymph glands present.

Six feet of bowel were exteriorized before a completely normal area could be found. The ileocecal junction and the terminal ileum were normal. The unusual appearance of the fluid, the scarlet red color of the bowel and the vagueness of the pathologic condition could not be correlated with either a diagnosis of regional ileitis or of mesenteric thrombosis. A diagnosis of Henoch's purpura was suggested by one of the house staff. Early mesenteric thrombosis of the venous type was considered most probable and resection was decided upon. In the usual handling of the bowel to determine a site for resection multiple tiny red hemorrhagic areas occurred at the bowel-mesenteric junction, wherever blood vessels were present. (Fig. 1.) These had not been noted when the bowel was first exteriorized. Also, the handled bowel became duskier, although this might have been due to compression of its mesentery by the wall of the incision. In view of this unusual extravasation of blood on minimal handling it was considered hazardous to resect the bowel inasmuch as the trauma of resection and suture would undoubtedly aggravate or extend this tendency. Therefore, all but about 2 feet of bowel was replaced in the abdomen. The exteriorized bowel was carefully packed off, covered with vaseline gauze and the operation terminated. It was noted that this exteriorized loop contracted and seemed viable, including the few inches of actively involved area. Ten milligrams of vitamin K were given intravenously on the table because of the unknown bleeding diathesis. Whole blood, 500 cc., was also given and Wangensteen suction initiated and continued for several days postoperatively. On the patient's return to the ward the tourniquet test did not reveal any abnormal capillary fragility.

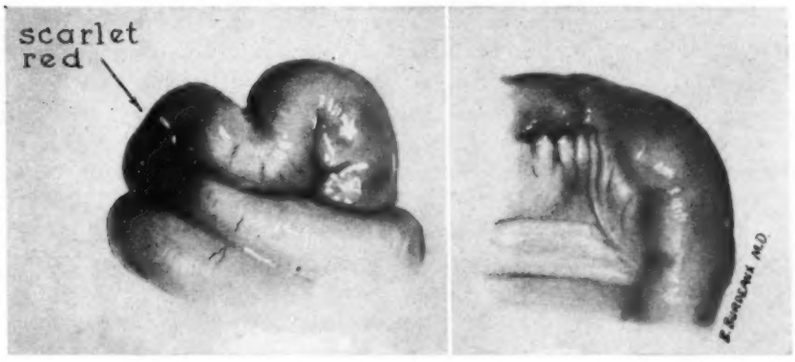
FIG. 1. Diagrammatic representation of the points of hemorrhage produced on handling of the bowel at operation.

The next morning the following laboratory procedures were reported: bleeding time one and a half minutes, coagulation time two minutes, prothrombin time thirteen seconds (100 per cent). Fragility test: hemolysis began at .44 per cent and ended at .30 per cent with a similar normal control. Platelet count was 290,000, red blood cells 4,630,000, 78 per cent hemoglobin, white blood cells 9,000, 79 per cent polymorphonuclears, 21 per cent lymphocytes and 2 per cent eosinophils. The serum proteins, non-protein nitrogen, plasma chlorides and CO_2 combining power were normal. Daily white counts were within normal total range except for the following eosinophilia on successive postoperative days: 2, 7, 9, 17 and 7 per cent. On the first postoperative day the removal of the vaseline gauze resulted in considerable oozing of blood; the bowel seemed less thick and perfectly viable. (Fig. 2.) On the second day the affected part was evidenced by a slight constriction which cleared up by the fourth day. The bowel at this time looked as it did at the subsequent operation. (Fig. 3.) The temperature fluctuated between 101° and 103°F. for the first five days postoperatively and then dropped to normal. On the sixth postoperative day the bowel was replaced in the abdomen which was closed without drainage. Convalescence was uneventful and the patient was discharged on December 13th, the twentieth day postoperatively. A few skin tests with food antigens were inconclusive but the patient refused further study.

Since then he has been entirely well. He returned to work as a bartender for several months and then worked as a laborer in construction work. Follow-up in March, 1949, sixteen months postoperatively, found him in good health. He had two minor episodes of stomach upset following alcoholic excesses. These were typical "hangover" episodes. He stated that his bowel habits were usually normal as before. If he needs a laxative, he simply takes half a glass of ordinary milk, resulting in good cathartic action without particular cramps. He still believes that peppers bother him and he avoids them; otherwise he eats anything. He has not taken bromo seltzer since his operation.

COMMENTS

The clinical picture of abdominal allergy has been amply covered in the literature and will be briefly reviewed only insofar as it is relevant to our topic. Our main interest, however, lies in those cases which will come to operation



2 3

FIG. 2. Taken twenty-four hours postoperatively; shows the affected area demonstrated by spasm only. Rest of bowel is dilated; the bowel shows the scarlet red color seen at operation in the residual area, but is not well marked. FIG. 3. Taken six days postoperatively; the bowel is homogeneous throughout in appearance. The deposition of pigment at the junction of the mesenteric vessels and bowel is present as expected following the hemorrhagic diathesis seen at operation. These are also seen in strangulated lesions of the bowel and any condition with hemorrhage, according to Laufman (personal communication). The absence of enlarged mesenteric glands is clearly shown. Compare with artist's drawings of these as well as photographs and drawings of regional ileitis in Figures 6 and 7.

and in which failure to recognize the entity may result in further unnecessary procedures.

A history of digestive disturbance is probably the most common of all symptoms in clinical medicine, sometimes on an organic basis but more frequently on a functional basis. This functional group can have many etiologies, single or in combination, as for example psychic, endocrine, hormonal, nutritional, toxic, reflex from other systems and last but not least allergic. It is important to distinguish digestive symptoms in an allergic individual from the true allergic gastrointestinal manifestations. The generally accepted modus operandi of this latter is as follows: An antibody comparable to the skin-sensitizing antibody is present in the mucous membrane of the gastrointestinal tract of the allergic individual, whether hereditary or acquired. The necessary allergen, whether it be the whole protein or a split product of protein digestion, arrives at this "sensitized site" either directly as enroute through the gastrointestinal tract or by way of the circulation, i.e., absorption into the portal system then via the general circulation into the mesenteric vessels. In either case the antigen-antibody combine causes an edema-erythema (wheal) response which in turn reflexly stimulates peristaltic contractions and spasm.[8] In the acquired allergies a true muscle-sensitizing antibody may also contribute to the smooth muscle spasm. The union of antigen with a sensitized cell is considered to cause the liberation of a histamine-like substance which through alteration of tissue-cell permeability causes the final physiologic result.

Andresen states[9] that "to produce the marked reaction in these diseases" (referring to ileitis and ulcerative colitis) "the exciting cause must be constantly operative; that is, the food or other agent must be eaten, inhaled or absorbed every day. . . . The allergic reaction may be due not only to sensitization to food or other ingesta but to bacteria (as in focal infections) and to inhalants (pollens and the like)." It is generally accepted, however, that these allergies are usually due to ingested antigens rather than to contact and inhalation.

The production of an allergic reaction of the bowel experimentally has recently been done by Walzer and his associates,[3,5] In their experiments, "With the onset of the allergic reaction, blanching of the affected gut (ileum and colon) developed, followed in a short time by local swelling and edema. Hyperperistalsis became noticeable in this region of the bowel, and in some instances, definite tonic contractions, lasting for five or ten minutes at a time, were noted at the sensitized area. On section of the bowel, the mucous membrane revealed the usual picture of hyperemia, marked edema and hypersecretion. Microscopic examination of

tissue taken from the site of the allergic reaction showed the lining cells of the mucosa to be only slightly involved. The submucosa in particular, and, to some extent, the serosa were edematous. Their vessels were distended and showed margination of the white blood cells.

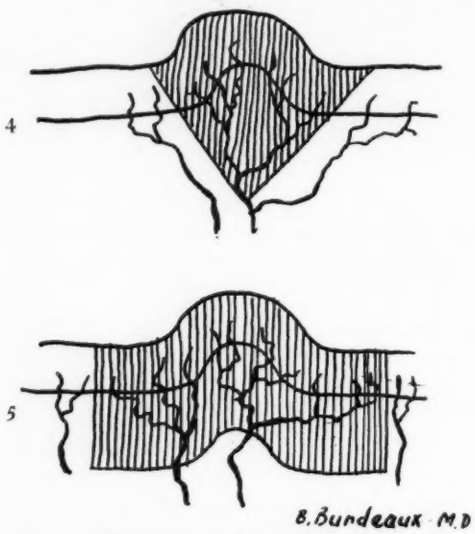


FIG. 4. Diagrammatic representation of infarct produced by vascular occlusion of the bowel.
FIG. 5. Diagrammatic representation of the block-shaped involvement of the bowel and mesentery, according to Kaijser.

Around the vessels and throughout the tissues were infiltrations of eosinophiles, lymphocytes, large mononuclear and some polymorphonuclear leucocytes."[5]

Walzer[11] states he has not seen this picture clinically and that the "purely allergic phase is so transitory that it is gone by the time the patient gets to the operating room." The ileum is most often affected. Kaijser states that 99 per cent of the cases occur in this area.[6] Althausen et al.[12] report cases of Henoch's purpura in which some showed small and large hemorrhages in the visceral peritoneum of the intestine and others edema involving the intestine or the stomach. One case showed edema of the gallbladder, and at subsequent operation small whitish papules were seen on the visceral peritoneum which were especially numerous over the appendix. Poll[13] reports one case with the entire intestinal tract intensely congested and edematous and another in which the mucosa of the appendix was studded with pin point hemorrhages. Fraser[14] found free fluid in the peritoneal cavity with the gut wall and mesentery studded with petechial hemorrhages and ecchymosed patches. Pierini[15] has reported one case with a large amount of serosanguineous fluid in the peritoneal cavity. The small intestine was dilated, cyanotic and with frank clapotage. Kaijser[6] states that at laparotomy certain findings should suggest an allergy. One differentiating point is that the swollen part goes into the mesentery without having any fixed borderline or line of demarcation. He states that it has been mentioned that the change in the mesentery looks like a band parallel to the intestine as compared to the mesenteric infarction which typically has a V-shape. (Figs. 4 and 5.) Theoretically, pulsation of arteries should be felt in the allergic bowel but this cannot be depended upon. Another statement which is not absolute is that the distal border of the lesion is clear and the proximal border is diffuse and not so well defined. Microscopically, the findings were similar to those of Walzers'[5] with edematous submucosa and infiltration with inflammatory cells, especially eosinophils. Similar findings from various portions of the gastrointestinal tract have been reported by others.[10,16,17,25]

In advanced lesions, whatever the etiology, the treatment will be definitive surgery such as resection, reduction of an intussusception, etc. In the type which we are trying to define the picture will resemble either mesenteric thrombosis or early regional ileitis. (Figs. 6 and 7.)

Barnes and Duncan[18] reported a case in which "much of the small bowel was seen to be collapsed and was in striking contrast to the last two feet of the ileum, which was greatly congested, thickened and edematous. Many subperitoneal hemorrhages were present in this area, and the appearance and feel of the affected bowel suggested that the underlying pathology was that of acute regional ileitis. The mesenteric glands were not enlarged." Nine days later the wound broke open demonstrating the fact that the ileum was perfectly normal.

In the allergic conditions without frank hemorrhage the bowel will resemble early acute regional ileitis very closely since in this condition it is also acute, swollen, congested and will often show punctate hemorrhages in the subserosa.[19] There will be no acute enlargement of the lymph glands as seen in typical regional ileitis. There is no question about viability in these cases regardless of the

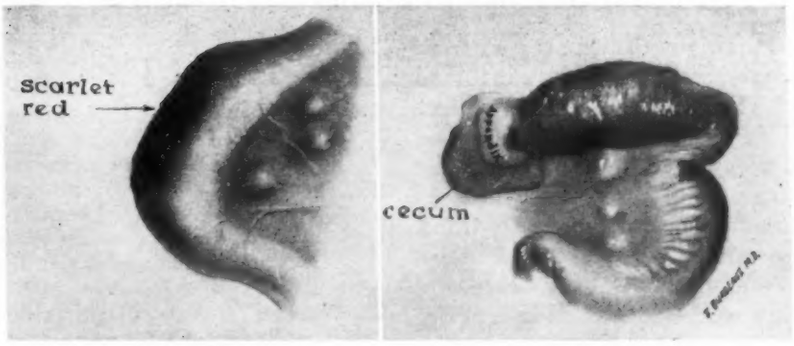


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FIG. 6. Artist's drawing of findings at operation in case of early regional ileitis; the enlarged mesenteric glands are prominent. The affected bowel (much enlarged for demonstration purposes) is bright red and the serosal area torn with the muscular fibers showing as transverse rugae. Adrenalin was used without visible change in the appearance. The appendix was removed in this case; no other surgery was done. There was no recurrence on April, 1, 1949, six months postoperatively.

FIG. 7. Shows artist's interpretation of case of moderately advanced regional ileitis; the mesenteric thickening and enlarged mesenteric glands are clearly seen. Resection with primary ileotransverse colostomy was done with excellent result; patient last seen four months postoperatively, April 1, 1949.

etiology, and definitive surgery is not indicated at this time if the correct diagnosis is made. None of our personal early acute cases of ileitis[20] have progressed as has been the experience of other authors. In the light of our present study we agree with Andresen that some of these cases were probably due to allergy. This would account for the lack of progression and also for failure to develop the fistulas on removal of the appendix.

In retrospect, our case presented the typical salient features of an acute intestinal allergy. The bowel was bright red, the fluid crystal-clear, with the border of the affected portion well demarcated distally and diffuse proximally. The mesentery was block-shaped with no suggestion of the V-shape seen in mesenteric thrombosis. The tendency toward hemorrhage and diapedesis on minimal handling was so prominent as to call attention to the possibility of allergy. There was no enlargement of the mesenteric lymph glands.

The acute "belly aches" always accompanying the eating of green peppers and the very definite laxative effect of small amounts of milk suggest an allergic basis in spite of the absence of the usual signs. The constant use of large amounts of headache powders prior to hospitalization is also suggestive.[9]

The use of adrenalin as a differential test was first used by Gregoire[6] and has been emphasized by Kaijser[6] and Pierini.[15] Adrenalin might also aid in differentiating "regional ileitis" due to allergy. The use of antihistaminic substances also should be valuable in making the differential diagnosis.

A diagnosis of allergy is easily made in the case in which a single antigen can be found which produces the typical attack (asthma, urticaria, angioneurotic edema). That this is not the usual state of affairs is explained in a comprehensive review of the subject by Rackeman.[21] In cases of gastrointestinal allergy there are so many variants that the exact etiology is very difficult or impossible to find according to Kaijser.[7] This statement sounds reasonable according to Walzer's work.[4,5] To get the necessary concentration of the antigen to the sensitized area of the bowel at the proper time presupposes a combination of events which it would be impossible to control in ingestion experiments. That this can occasionally be done has been shown by x-ray studies[22,23] in isolated cases in the literature. In cases such as ours checks may have to be repeated over periods of years before the correct antigen is found, as brought out by Andresen.[9]

CONCLUSIONS

Allergic manifestations of the gastrointestinal tract are characterized by serohemorrhagic effusions into a localized portion of the bowel wall. There is a variable amount of crystal-clear to serosanguineous fluid in the abdominal

cavity. The affected part is thickened and edematous and is fairly well demarcated from the surrounding tissue. The amount involved may vary from a few inches to several feet. The serosa is bright red in color with no fibrinous or purulent exudate. There may be hemorrhagic spots in the subserosa and mesentery varying from punctate areas to frank hemorrhages. The mesentery shows some thickening but this is not marked and the mesenteric lymph glands are not enlarged. The arterial circulation in the mesentery is intact and the bowel and mesentery are likely to be affected in a block-shaped manner as against the V-shaped involvement of mesenteric thrombosis. There is a hemorrhagic diathesis present as evidenced by an unusual amount of diapedesis and hemorrhage of the terminal arterioles of the mesentery on minimal handling of the tissues. Unusual care must be taken in this respect as Kaijser[6] reports a case in which the hemorrhage was so marked as to necessitate resection. The use of adrenalin or some antihistaminic agent is indicated both as a diagnostic test and for treatment. Resection should not be done except in cases in which there is an advanced irreversible pathologic condition.

Of necessity, there will be variations from the aforementioned depending on the duration and severity of the reaction in the tissues. Just how many of the various factors are necessary for an immediate diagnosis cannot be stated with any authority at this point. It is hoped, however, that this study will stimulate others to report their cases and thus aid in clarifying this obscure clinical picture.

SUMMARY

1. Allergy plays a part in the production of an acute condition within the abdomen and not infrequently results in surgical intervention.

2. A review of the literature has been presented demonstrating that this is more frequent than is currently recognized.

3. A typical case has been presented in detail.

4. Analysis of the literature and our own case demonstrates that allergy of the bowel results in a sufficiently characteristic appearance to be recognizable at operation.

5. The similarity of allergy of the bowel to mesenteric thrombosis and regional ileitis has been noted and the use of adrenalin and the antihistamine drugs as a means of differential diagnosis has been suggested.

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CLINICAL STUDY OF THE FATE OF HOMOGRAFTS IN MAN*

EFFECT OF REPEATED DOSAGE FROM THE SAME DONOR AND OF REFRIGERATION ON THESE GRAFTS

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HOMOTRANSPLANTATION of human tissues has intrigued the medical profession almost since the beginning of our civilization. It was not idle curiosity that lured the various investigators into this field but a desire to procure permanent survival of homografts, an accomplishment of great surgical importance. There are the fields of endocrinology, reconstructive surgery, orthopedics, plastic surgery and many others in which successful homotransplantation would open up new horizons in the treatment of deficiencies and defects. The reports in the literature on this subject have been conflicting ones. It is true that homografts take well and may remain viable for different periods of time. Indeed, during the first few weeks homografts may be indistinguishable, grossly or histologically, from autografts. Most workers agree, however, that homografts do not survive permanently in the new host and sooner or later they disintegrate.

The reports of successful homotransplantation of tissue presumably are due to the fact that either the observations are not extended over a sufficiently long period of time in which case the initial "take" is interpreted as a pemanent survival, or as is the case with skin homografts the epithelium of the host which frequently overgrows the disintegrating homograft is erroneously considered to be the surviving epithelium of the donor.

The results of homografting of skin have been as varied in their final result as the homotransplantation of other tissues. Several comprehensive reviews of the literature on skin homografting have appeared in recent years.[1–6] The majority of investigators now concur in the opinion that skin homografts survive only for a short time and cannot be regarded as permanent skin grafts. However, the primary reason for persistent experimentation in skin homografting is its use as a life-saving measure. The presence of extensive open wounds in young children and debilitated individuals often lead to a critical condition when it is imperative to skin graft the denuded area at once. Frequently there is little available skin for autografting, or the patient's condition does not permit the addition of the surgical trauma incurred in the removal of skin. In such situations homografts help to tide the patient over the critical period, improve the general condition by removing areas of sepsis, curtail leakage of plasma and permit subsequent autografting with less risk to the patient. Moreover, further experimentation in the methods of treating homografts may possibly lead to a refinement of technic which will permit their permanent survival.

Although it is universally accepted that skin grafted at random from one individual to another does not survive permanently, there is no unanimity among the investigators[1,2,7–28,30] regarding the mechanism responsible for the ultimate disintegration of the graft. The theories of the mechanism underlying the failure of permanent survival of skin homografts fall into three groups, namely, natural immunity theory (blood groups) supported by Davis (1917), Shawan (1919), Masson (1918) and others; cellular theory (organismal differentials), Loeb (1930), Padgett (1932, 1942); active immunity, Gibson and Medawar (1943), Medawar (1943, 1946).

Because of these conflicting theories and since most of the important experimental work had been conducted on laboratory animals, the results of which may not always be directly transposed to man, this experimental study of homografting was undertaken on man.

The scope of this paper includes, (1) observation of the behavior of large homografts in man and the comparison, grossly and

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histologically, with simultaneous autografts; (2) the study of the fate of skin grafts by means of sequence of biopsies taken at regular intervals and comparison of the length of survival of autografts and homografts; (3) the reaction of the host to several successive fresh homografts ("second and third set" or more) from the same donor; (4) the influence of pretreatment by cold on the survival of homografts was studied and the results were compared with the observation of other workers. An attempt was made to correlate our observations with the prevalent theories of host reaction to foreign tissue and to appraise critically the value of skin homografting in man and its future potentialities.

METHODS OF STUDY

Before proceeding with the outline of the technic followed in these experiments it is pertinent to devote a few lines to discussion of the terminology relevant to the work in transplantation of skin.

Autograft is used to denote a skin transplant from one area to another in the same individual; homograft is a skin graft transplanted from one individual to another of the same species. First set, second set and third set homografts are successive transplantations of skin from the one individual to the same recipient after arbitrarily chosen intervals of time. All homografts used in this report were split-skin dermatome grafts from 0.010 to 0.016 inches in thickness. Clean denuded areas are fresh wounds formed by excision of scars or of skin. Granulation tissue is referred to areas of third degree burns or denuded areas of long standing that have not been epithelized. Graft bed is the area of host's tissue underlying the transplanted skin. Take will be used to mean an initial take of the transplant and survival should be construed as permanent survival.

The donor and recipient areas were prepared with green soap, alcohol and zephiran. The grafts were obtained with the Padgett dermatome and were 0.014 to 0.016 inches in thickness for adults and 0.010 to 0.014 inches for children. Firm, red, healthy, granulating areas were not disturbed, but pale and edematous or exuberant granulations were shaved off with a scalpel until the underlying vascular bed was reached. The grafts were placed on the recipient area and sutured under normal skin tension with interrupted dermalon sutures. Adequate pressure was obtained with firmly applied rolled bandages followed with adhesive tape. The extremities were invariably immobilized with padded splints. In other regions measures were taken to prevent undue movement of the patient's body to ensure an optimum take of the skin graft. The first dressing was usually done between the fourth and seventh day at which time a biopsy was taken. Subsequent dressings were done at weekly intervals or more frequently as indicated. Biopsies were taken from representative areas and where possible at a junction with two transplants or of a transplant with the host tissues. The sections were stained routinely with hematoxylin and eosin, Masson stain, elastic tissue stain and occasional phosphotungstic acid when indicated. Frequent photographs in black and white and in kodachrome were taken to facilitate follow-up.

Some of the homografts were grafted immediately upon removal from the donor. In others the remaining skin was folded, raw surface to raw surface, rolled in cigarette fashion, wrapped in gauze wrung out in saline and inserted into a glass bottle and stored at different temperatures. In most cases biopsy of the refrigerated skin was obtained prior to grafting to determine its cytologic appearance.

EXPERIMENTAL OBSERVATIONS

Our observations on homografts extend over a period of four years. A total of sixty-two homografts were applied to thirty-five patients. Of these grafts twenty-one were fresh and the remainder were subjected to varying degrees of cold from 45° to 108°F. for different periods of time. Homograft transplantation of skin was in many cases done as an emergency measure to tide the patient over a critical condition when debilitation became pronounced or when the resistance to infection was at a particularly low ebb. In four cases the skin of one of the parents was utilized for homografting. Although the technic of skin grafting, the nature of dressing changes and other procedures were essentially similar, there are variables inherent in the condition of granulation tissue and the rapidity of healing processes which were different for each of the cases presented. The detailed accounts of some of the

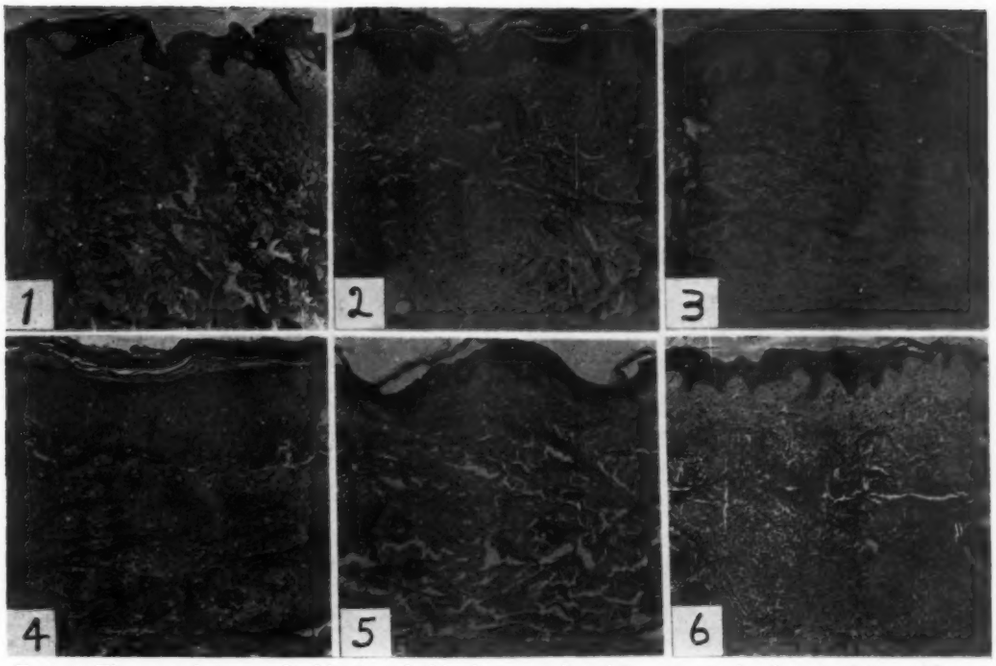


FIG. 1. First set homograft, biopsy of skin homograft taken one week after grafting. (Hematoxylin and eosin × 70.)
FIG. 2. First set homograft, biopsy of skin homograft taken two weeks after grafting; cellular infiltration of the dermis is marked; collagen bundles are swollen; the epithelium is intact. (Hematoxylin and eosin × 70.)
FIG. 3. First set homograft, biopsy of skin homograft taken three weeks after grafting; epithelial cells are swollen and faintly stained; cellular infiltration is marked. (Hematoxylin and eosin × 70.)
FIG. 4. First set homograft, biopsy of skin homograft taken four weeks after grafting; the disintegration of epithelium is advancing; the nuclei are pyknotic and cellular details are difficult to identify. The collagen fibers are pushed apart by cellular infiltration, most marked in subepithelial layer. (Hematoxylin and eosin × 100.)
FIG. 5. Second set homograft, biopsy of homograft taken one week after grafting (two weeks after the first set); note the swelling of collagen fibers and beginning of cellular infiltration. (Hematoxylin and eosin × 80.)
FIG. 6. Second set homograft, biopsy of homograft taken two weeks after grafting (three weeks after the first set); note the marked cellular infiltration. (Hematoxylin and eosin × 80.)

patients are presented later in the form of protocols.

CASE REPORTS

CASE 1. G. P., a three and a half year old male, was admitted to the hospital on April 9, 1945, after his overalls caught fire. On admission there were second and third degree burns over all of the left leg, thigh and buttock (about 20 per cent of body surface). He was given 300 cc. of plasma and tetanus antitoxin. Occlusive pressure dressing was applied to the burned leg. On April 14th the wound appeared infected and the culture yielded Staphylococcus pyogenes. Penicillin cream was applied to the burned areas and the patient was placed on sulfathiazole. Three weeks after admission the wound had only a light growth of Staph. pyogenes and it was decided to skin graft the entire area. One large split-skin homograft (0.016 inches) from the father's abdomen was applied to the upper part of the thigh. Two large autografts (0.014 inches) were also applied to the remaining bare area of the thigh and popliteal fossa. During operation 700 cc. of blood were given. The grafts were sutured in the usual manner and occlusive pressure dressing was applied. A full dermatome graft of the father's skin was stored at 4° to 5°C. and used as a source for subsequent homografting.

The dressing was changed one week later; biopsy was taken at that time (Fig. 1) and the "second set" homograft, stored at 4° to 6°C. for seven days, was applied to the posterior aspect of the calf. One week later the "third

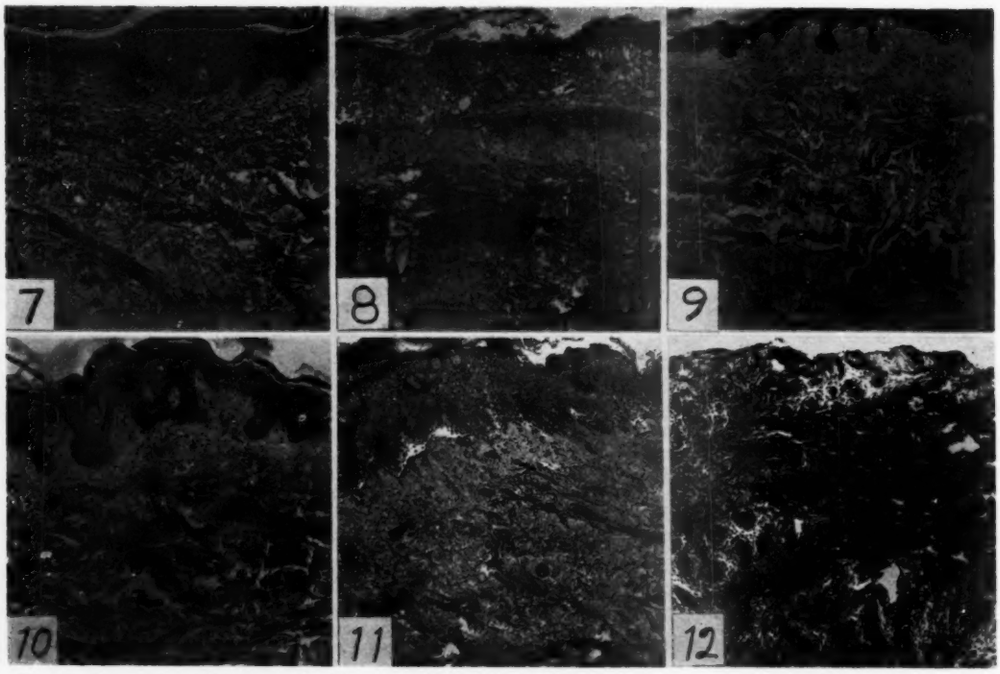


FIG. 7. Second set homograft, biopsy of homograft taken three weeks after grafting (four weeks after the first set). Cellular infiltration of the dermis is very marked; the collagen fibers are swollen and pushed apart by the inflammatory cells. (Hematoxylin and eosin × 100.)

FIG. 8. Second set homograft, biopsy of homograft taken four weeks after grafting (five weeks after the first set.) Epithelial disintegration is complete although some cellular outline can be made out in basal layer. (Hematoxylin and eosin × 70.)

FIG. 9. Third set homograft, biopsy taken one week after grafting (three weeks after the first set); beginning of cellular infiltration is evident at the base of the graft. (Hematoxylin and eosin × 80.)

FIG. 10. Third set homograft, biopsy taken two weeks after grafting (four weeks after the first set). Epithelial swelling is marked; there is also swelling of collagen fibers and extensive cellular infiltration. (Hematoxylin and eosin × 80.)

FIG. 11. Third set homograft, biopsy taken three weeks after grafting (five weeks after the first set). Epithelial disintegration is advanced; all outlines are indistinct and nuclei are pyknotic; shredded remains of collagen bundles are seen throughout the dermis. (Hematoxylin and eosin × 80.)

FIG. 12. Third set homograft, biopsy taken four weeks after grafting (six weeks after the first set.) The disintegration of all layers of skin is complete and cellular reaction is very conspicuous. (Hematoxylin and eosin × 80.)

set" homograft (stored for fourteen days) was applied to the granulating area on the anterior aspect of the lower leg; biopsies and photographs were taken. (Figs. 2 and 5.) Both autografts and homografts took well although the homografts were more purple in color than the former; microscopically, the epithelium of the homograft was still intact.

The dressings were changed again at weekly intervals and on all these occasions biopsies and photographs were taken. (Figs. 3 to 12.) The "first set" homograft appeared to be intact, grossly, up to the fifth week after the initial grafting; microscopically, there was evidence of beginning epithelial degeneration at the end of the fourth week. (Fig. 4.) The "second set" homograft was grossly normal up to the fourth week; microscopically, at the third week there was a marked cellular infiltration predominantly of plasma cells. (Fig. 7.) The "third set" homograft appeared on gross examination to be intact except for a few blebs due to extravasated serum at the end of the second week. Microscopically, intact epithelium and only a moderate degree of spongiosis were seen at the end of two weeks, but the epithelium became necrotic by the end of the third week. By the beginning of the seventh week after first grafting, all vestige of epithelium was gone in all homografts. Ultimately, autografts were applied

and the boy was discharged from the hospital in a satisfactory condition.

The summary of the salient features of this case are presented in tabular form in Table 1. The appearance of the grafts at the end of two weeks is shown in Figure 13. At no time during the patient's stay in the hospital was there evidence of any specific reaction to the presence of homografts.

Case II. D. D., a five year old male, was admitted to the hospital on December 26, 1942, after scalding himself with hot coffee. On admission there were second and third degree burns of the anterior and posterior aspects of his chest and left side of face and neck estimated to extend over 20 to 25 per cent of his body surface. The shock was combatted with an adequate amount of plasma. The burned area was washed with saline and green soap and several eschar-producing agents were applied. Subsequently, numerous pockets filled with pus and debris formed under the eschar. Since the boy's general condition was not improving, surgical removal of the eschar was carried out. Four weeks after admission he was given a transfusion of 300 cc. of whole blood and placed on sulfathiazole again.

Six weeks after admission five split-thickness (dermatome) grafts (0.012 inches) were removed from the boy's thighs and applied to the granulating wound on his back. Two other large split-thickness grafts (0.014 inches) from the thigh of the boy's mother were also applied to the same area. Pressure dressing was applied by means of cotton waste, rubber sponges and roller bandages.

The first dressing was done on the third postoperative day; the second dressing three days later; both homografts and autografts showed a good initial take and there was little pus or infection. On the sixteenth postoperative day beginning epithelial desquamation was noted in the homografts and granulation tissue was growing through the areas corresponding to perforations and the junction with other grafts. Twenty-one days after grafting all epithelium had disappeared from the homografts although the dermis appeared intact. One month after grafting all maternal grafts appeared to have disintegrated grossly.

The boy's condition was markedly improved. The granulating area was then covered with split-thickness autografts from the boy's abdomen and he was discharged in good condition four weeks later.

Fig. 13. Photograph of the leg of the patient discussed in the protocol of Case I taken two weeks after grafting of the first set homograft, marked H above the knee and one week after the second set homograft (H near ankle). A-autografts grafted simultaneously with the homografts.

Case III. E. F., a four year old female, was admitted to the hospital on April 5, 1944, with extensive burns of the back, buttocks and both thighs extending over 25 per cent of her body surface, sustained when she fell into a tub of scalding water. The burn occurred two months prior to admission and she was treated for that period of time in another hospital (treatment unknown). The wounds were treated locally with gauze and sulfathiazole emulsion. She was given a blood transfusion and placed on a high protein, high vitamin diet. At the time of grafting the raw, granulating area extended over about 20 per cent of the body surface.

Four weeks after admission dermatome split-thickness autografts (0.012 inches) from

TABLE 1

HISTOPATHOLOGIC REACTION TO MULTIPLE SET HOMOGRAFTS, (PROTOCOL OF CASE 1)

Time after Grafting (wk.)	First Set* Homograft	Second Set* Homograft	Third Set* Homograft
1	H–7†	H2–7	H3–7
	Epithelium is intact and cytologically normal; no cellular infiltration	Epithelium is intact and shows normal staining reaction without edema	Epithelium is well stained and there is no edema
	Dermis, the vessels are well filled; collagen fibers are well preserved; there is no suggestion of perivascular cuffing	Dermis is composed of large, well and uniformly stained collagen bundles; also some perivascular infiltration with cells (mononuclears); these form small foci, but the cellular reaction is less marked than in the first set homograft (H–14)	Dermis, collagen fibers are better preserved and show a better staining reaction than the second set homograft (H2–14); perivascular infiltration with mononuclear cells is only moderate and foci of these cells are only occasionally seen
	Graft bed, section shows only a small portion of bed which is apparently normal	Graft bed is composed of granulation tissue made up of fibroblasts, lymphocytes and occasional plasma cells; subcutaneous fat is present	Graft bed is similar to the bed of the first set homograft (H–21) but plasma cells predominate in the cell population here
2	H–14	H2–14	H3–14
	Epithelium is intact; foci of inflammatory cells reach junction with dermis; intercellular edema noted in some areas of epithelium	Epithelium shows normal-staining reaction except for numerous areas of spongiosis (intercellular edema)	Epithelium is intact and well stained; moderate intercellular edema is present (spongiosis)
	Dermis, foci of lymphocytes, monocytes and plasma cells are noted among the collagen bundles which are separated and show different staining reaction	Dermis, collagen bundles show variable degree of staining; there is moderate diffuse infiltration of inflammatory cells in the lower portion of the dermis; there are foci of inflammatory cells (plasma, lymphocytes and monocytes) in the area of junction of the dermis with the underlying graft bed	Dermis, collagen bundles are well stained and only slightly fragmented; upper layer of dermis shows a moderate degree of diffuse cellular infiltration; lower down the blood vessels are congested; the capillaries are stuffed with red blood cells; perivascular "haloing" with mononuclear cells is marked
	Graft bed is composed of granulation tissue made up of fibroblasts, lymphocytes and occasional plasma cells; also a number of macrophages with brown pigment	Graft bed is more cellular but less fibrous than H–21; numerous eosinophiles are present	Graft bed, the granulation tissue of the bed is about the same degree of maturity as 3 weeks' old second-set homograft (H2–21); cellular exudate is made up chiefly of plasma cells
3	H–21	H2–21	H3–21
	Epithelium is intact and apparently healthy; some areas show the beginning of spongiosis (intercellular edema)	Epithelium shows some loss of staining power and considerable amount of spongiosis; however, the staining is deeper and edema less marked than the first set homograft	Epithelium is necrotic without any trace of basophilic property; the nuclei are pyknotic and cell outlines remain only in basal cells; there is a beginning separation of epithelium from dermis; cellular infiltration is absent
	Dermis is vascularized and shows several foci of inflammatory cells; collagen bundles show variation of staining reaction, more pronounced in the upper layer	Dermis, collagen bundles are separated by inflammatory cells and stain irregularly; the cellular infiltration is more marked as one approaches the epithelium. (Reaction is more diffuse than in "first set" homograft)	Dermis, collagen bundles are fragmented and the staining reaction is variable; cellular infiltration is less striking and perivascular cuffing less marked than a week before; blood vessels are congested with red blood cells; the capillaries extend up to the epithelium
	Graft bed is composed of connective tissue with several foci of chronic inflammatory cells, (plasma, monocytes, lymphocytes and fibroblasts)	Graft bed is made up of a fairly dense fibrous tissue; foci of cellular infiltration are predominated by plasma cells	Graft bed, the granulation tissue is made up of young fibroblasts and there is a moderate inflammatory reaction of lymphocytes, plasma cells and macrophages

TABLE 1 (*Continued*)

Time after Grafting (wk.)	First Set* Homograft	Second Set* Homograft	Third Set* Homograft
	H–28	H2–28	H3–28
	Epithelium in one area lies directly on the graft bed; epithelium is edematous with feeble staining reaction	Epithelium is lifted off the dermis and only the basal layers remain attached; the lifted portion is necrotic and is dotted with the remains of fragmented pyknotic nuclei	Epithelium, none visible anywhere; granulation tissue is encroaching on the remains of the graft
	Dermis is infiltrated with inflammatory cells; collagen is fragmented	Dermis, collagen bundles are fragmented and separated; the cellular infiltration is diffuse but is only moderate in degree; the upper layer of dermis shows very marked vascular congestion; apparently extravasated blood is found throughout the dermis and extends to the spaces formed by separating epithelium	Dermis, fragments of hyalinized connective tissue bundles appear edematous and swollen
4			
	Graft bed shows cellular infiltration to be less marked than H–21 and is made up of plasma cells, lymphocytes and occasional eosinophils; clusters of multinucleated giant cells are present	Graft bed, the granulation tissue is fibrous and infiltrated predominantly by plasma cells	Graft bed shows well vascularized granulating tissue diffusely infiltrated with lymphocytes, plasma cells and polymorphonuclears; there is also perivascular collaring of same cells
	H–35	H2–35	
	Epithelium is strikingly abnormal; the basal layer is not continuous, it is replaced by foci of polymorphonuclears; the remaining portion of epithelium is edematous and cells appear dead; polymorphonuclears are numerous	Epithelium, none can be identified	
5	Dermis, upper layer pale and edematous, infiltrated with acute and chronic inflammatory cells; occasional macrophages	Dermis, fragments of collagen bundles are swollen and fragmented	
	Graft bed, fibrous tissue infiltrated with plasma cells and lymphocytes; a single nest of foreign body giant cells is present		

* First, second and third sets refer to successive homografts from some donor to one patient and correspond to H, H2 and H3, respectively.

† Numeral following letter indicates the number of days after grafting of the particular set of homografts at which time the biopsy was taken.

the child's back and two full sheets of homografts (0.016 inches) from her father's abdomen were applied to her back and buttocks. She was given 400 cc. of blood during the operation. The first dressing was done on the sixth postoperative day. Both homografts and autografts appeared healthy and infection was minimal; biopsies were taken of both homo- and autografts. Subsequent dressings were done at weekly intervals at which time biopsies and photographs were taken. Some necrosis appeared at the edges of the homograft on the twenty-first postoperative day. One week later only a few strands of the epithelium remained on the homografts. At the end of five weeks only a few collagenous bundles were recognizable microscopically. The granulating area was ultimately covered

with autografts from the child's abdomen and the child was discharged one month later. At no time was there any evidence to suggest untoward reaction due to the presence of homografts.

CASE IV. D. P., a twenty year old female, was admitted to the hospital on February 20, 1945, for plastic reconstruction of advanced saddle nose due to congenital syphilis. There was a positive Wassermann reaction in the blood, but the cerebrospinal fluid was negative.

Under local anesthesia a pedicle flap was raised from her right arm in stages and ultimately was swung over to her nose. She was immobilized in a cast for about four weeks to prevent undue movement of the pedicle graft. On May 10, 1945, a skin homograft from a non-related donor was applied to the granulating area on the right arm and dressed in the usual manner. The dressings were changed on the seventh postoperative day and subsequently from three to seven days. The graft showed a good initial take and remained in good condition for about four weeks. By the end of the fifth week there was no trace of epithelium either grossly or microscopically; biopsy at that time (June 14, 1945) revealed a diffuse infiltration of breaking up collagen fibers with lymphocytes, plasma cells and eosinophiles. The same cells were seen in aggregates in the perivascular areas and diffusely in the graft bed.

The patient's blood was of the following grouping: B, MN, Rh-negative; the donor's: A, MN, Rh-positive. Cross-agglutination done on June 22, 1945, (about six weeks after homografting) revealed a very high antigroup A titer in the recipient's serum (1:512). The donor being a "secretor" (i.e., having group-specific antigens dissolved in all body tissue fluids), it was thought that the high titer of the recipient's serum may have resulted from "isoimmunization" inherent in the transplantation of tissues containing some non-compatible elements. The patient did not show any systemic demonstration of a reaction either to the presence of the homograft or to its disintegrating residue.

On July 7, 1945, a split-thickness autograft was placed on the granulating area from the patient's own thigh under block anesthesia and healed uneventfully.

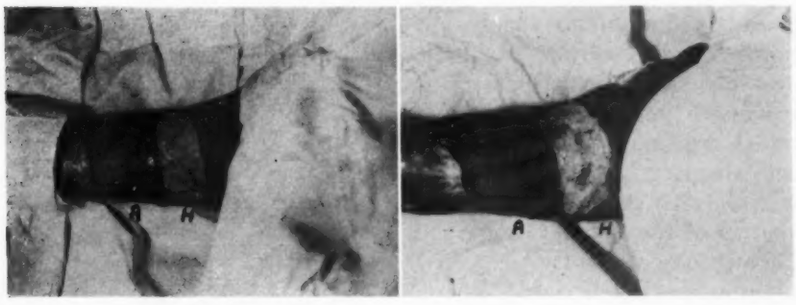
CASE V. S. L., a seven year old male, was admitted to the hospital on February 2, 1946, with second and third degree burns of the body and both legs, sustained when his clothes caught fire. The burned area extended over 25 per cent of the body surface and included the legs, abdomen, perineum and penis. He was placed on sulfathiazole and systemic penicillin. Xeroform gauze and pressure dressing were applied to the burned area. He received 1,000 cc. of plasma and 200 cc. of blood in the first forty-eight hours.

Three weeks after admission the granulating areas were cleaned off under general anesthetic and the debris removed. Two days later split-thickness grafts were applied to the granulating areas; one graft from the father's abdomen and two from the costolumbar area of the patient's own back. The patient received 570 cc. of blood during operation. Xeroform gauze and pressure dressing consisting of cotton waste, rubber sponges and roller bandages were applied.

On the fourth postoperative day the dressing was changed. The autograft had a few purulent blebs but otherwise looked well. The homograft took approximately as well as the autograft. Three days later another homograft, which was obtained from the patient's father and was stored for one week in a refrigerator at 4° to 6°C., was applied to the granulating area on the left thigh. Six days later the first homograft began to desquamate. The second homograft appeared to have taken well. The next change of dressing was done nine days later; biopsy and colored photograph were taken at that time. The surface layer of the epithelium on the homograft was peeling slightly, but the graft was in fairly good condition. The "second set" homograft showed free desquamation of epithelium and disintegration in some areas. There had been considerable movement of the boy's leg, and more rapid degeneration may have been due to mechanical irritation. Two weeks later another biopsy was taken. There was more peeling of epithelium of the first homograft and slight thinning of edges. The graft was still in good condition grossly. Within the next three weeks the homografts became completely disintegrated and biopsy on May 8th revealed only residual collagen.

Autografting was started at that time and the boy was ultimately discharged with all areas covered with autografts.

The preceding protocols of some of the



14 15

FIG. 14. Photograph of patient's arm showing the autograft (A) and the homograft (H) taken at the time of operation.
FIG. 15. Photograph of autograft (A) and of homograft (H) taken two weeks after grafting; this patient received five successive fresh homografts from the same donor at weekly intervals.

cases studied illustrate the manner in which observations were carried out in our experiments. Table 1 summarizes the pathologic findings of one of the cases in which three successive sheets of homografts from the same donor were applied. The homografts are designated as H for the first set, H_2 for the second set and H_3 for the third set and were applied on three occasions each at weekly intervals. The numerals which follow indicate the number of days after grafting of the particular set of homografts at which time the biopsy was taken. It should be noted that the second and third set of homografts were refrigerated at 4° to 6°C. for one and two weeks at this temperature. A period of two weeks usually does not interfere with their ability to survive. The implications of this pretreatment will be discussed subsequently in this article.

The length of survival of the epithelium was taken as the end point of survival of the graft because collagenous remnants of the dermis frequently persist for long periods before final disintegration and must not be considered to denote continuing survival of the graft. However, the table also includes the data concerning the state of the dermis as well as the graft bed. Examination of the state of epithelium for the respective sets of homografts at weekly intervals revealed that the first set survived for five weeks, the second set for four and the third set for three weeks.

In one other case the repeated homotransplantation of skin was carried out even further so that five successive grafts from the same donor were applied to one patient. (Figs. 14 and 15.) The conditions for skin grafting were not ideal; nevertheless, the first set survived twelve days and the subsequent sets were lost with increasing rapidity so that the fifth set homograft was lost on the fifth day. It is noteworthy that in spite of the repeated administration of homologous skin the patient showed no local or general clinical signs suggestive of sensitization.

The remainder of the fresh homografts were each applied to separate individuals. The longest period of survival of homografts in these experiments did not exceed five weeks according to the previously described criteria of survival.

COMMENTS

Three main theories concerning the mechanism that underlies the resistance to successful homografting have been elaborated over a period of years. The first is one of natural immunity based upon the incompatibility of the various blood groups and subgroups. The second theory is concerned with organismal differentials inherent in the cells of transplanted tissue, the reaction being considered to occur in or about the grafts themselves. The third theory is that of active immunity in which the reaction is based on the idea that the proteins or other ingredients of the grafted tissue are antigenic. Our observations tend to support the last-named hypothesis since in the cases in which successive sets of homografts were applied from the same donor the survival times of the later grafts progressively decreased. We have grafted skin from the same donor patient as many as five times and have extended the observations of Gibson and Medawar still further.[2] We ob-

served a progressive reduction in the length of survival. Some of the earlier available reports based on clinical observations alone should be accepted with great reserve. We have found that clinical appearance may be misleading; complete disintegration of the graft epithelium may take place and overgrowth of the persisting dermis of the homograft by the epithelium of the host may occur. Even marked subepithelial inflammatory reaction may escape gross inspection. These pathologic changes are obvious in microscopic examination of the biopsies.

Subjecting the homografts to the influence of cold introduced a new factor since it served to assess the effect of moderate and severe cold on the survival and apparent immunologic reaction of single and multiple sets of homografts. Refrigeration shortened the survival of homografts irrespective of the duration of storage.

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BLADDER STONES*

AN EXTRAVESICAL SURGICAL APPROACH

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VESICOLITHOTOMY as practiced by the use of a high cystotomy is not always followed with a postoperative course comparable to the patient's initial anticipated risk. It has long been recognized that this operation carried with it an unpredictable morbidity and mortality. It is for this reason that we considered the advisability of another approach and chose the prostatic capsular incision because of the appreciably better blood supply of this structure. Our method and experience are reported herein along with ten illustrative cases.

Anatomic Considerations. Wound healing is dependent upon a multitude of factors, the most important of which is the available blood supply. This we believe may account for the delay in healing of cystotomy wounds executed for vesicolithotomy. It is common to see these bladder wounds heal poorly, and this finding is in contradistinction to the cystotomy wound that is performed for vesical drainage alone. It would seem that the presence of the calculus must initiate some change which might secondarily affect the vascularity of the bladder fundus. Clinically, it is appreciated that the vesical fundus seldom affords sufficient bleeding to be troublesome upon incision. The presence of a calculus in the bladder may alter the blood supply to a further degree and so reduce its effectiveness. In any event, in an attempt to solve this perplexing problem it occurred to us that if fundal avascularity was a factor, incision through the prostatic capsule should certainly circumvent this possibility. In the execution of retropubic prostatectomy we found the prostate and vesical neck to be characterized by extreme vascularity but still quite amenable to satisfactory hemostasis. With these concepts in mind it was decided to initiate a series of vesicolithotomies through the prostatic urethra.

The arterial blood supply of the urinary bladder is derived from several rather variable arteries all of which take origin from the hypogastric arteries. Farabeuf and Tsaknis have studied the vesical blood supply rather thoroughly and through their efforts one can generalize to a certain extent regarding this phase of vesical anatomy.

The anterosuperior and posterosuperior vesical arteries are derived from a common trunk

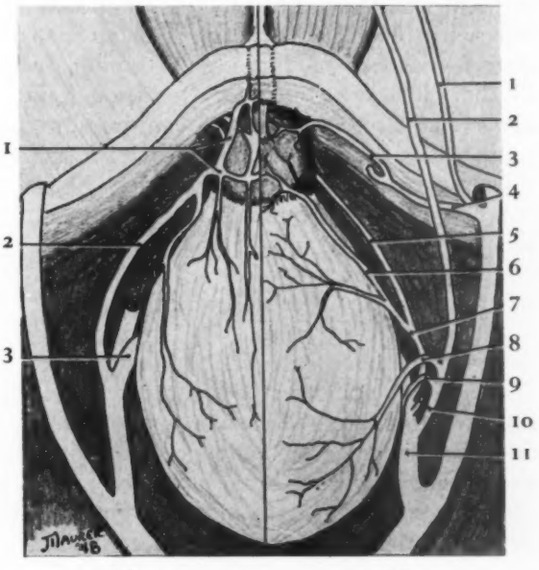

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FIG. 1. A, anterior view of the veins of the bladder; (1) Santorini's plexus; (2) lateral veins of bladder; (3) inferior vesical veins. B, anterior view of the arteries of the bladder; (1) epigastric artery; (2) umbilical artery; (3) ascending anterior vesical artery; (4) obturator artery; (5) prostatic artery; (6) vesical branch of genitovesical artery; (7) genitovesical artery; (8) anterosuperior vesical artery; (9) posterosuperior vesical artery; (10) superior vesical trunk; (11) hypogastric artery (after Tsaknis).

with the umbilical arteries. (Fig. 1.) These vessels supply the dome of the bladder. The genitovesical and prostatic arteries frequently derive from a common trunk, and after dividing into these respective branches, form the rich blood supply to the prostate, seminal vesicles and the bladder neck. The latter structure is

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supplied by the inferior vesical arteries. Thus the arterial blood supply to the vesical neck region is greater than that to the fundus, in proportion to the amount of tissue supplied.

The veins are not concomitant with the arteries but form a rich plexus on the anteroinferior aspect of the bladder. Here they merge with the veins of the prostatic plexus which lie within and upon the anterior surface of the prostatic sheath. The ultimate drainage is into the lateral vesical plexus and from there into the hypogastric veins. Therefore, it is readily apparent that the arterial and venous supply to the vesical neck region greatly exceeds that of the fundus.

Two of the primary requisites of tissue healing are immobilization of the wound and an adequate blood supply. The incision into the anterior aspect of the vesical fundus fulfills neither of these criteria, for even though drainage is instituted by means of a suprapubic tube in an effort to put the bladder at rest, the not infrequent occurrence of bladder spasms, coupled with abdominal respiratory movements, cause motion on the suture line. In addition, one has to deal with a granuating wound once the tube is removed.

Clinical Applicability. In ten recent cases we have removed calculi from the bladder by the method to be described and the unbelievably smooth course, the primary wound healing and the freedom from postoperative pain lead us to believe this to be a superior method in those cases in which the stones are no greater than 2 inches in diameter and in which no tumors of the bladder or remedial diverticulas coexist. We found that it was possible by persistent although forcible dilatation of the vesical neck to expand the opening so that calculi of more than 2 inches in diameter could be delivered. The vesical neck would contract immediately to its normal caliber and this process occurs under the observer's eye prior to reconstruction of the prostatic urethra.

The majority of vesical calculi seen in our clinic are secondary to obstructive conditions of the vesical neck, i.e., prostatism, vesical neck contracture, hypertrophied interureteric ridge and occasionally posterior urethral valves. The retropubic method allows one to correct simultaneously any of these conditions far more satisfactorily than is possible when the transvesical approach is used. Postoperative urinary drainage is effected by means of a urethral catheter only, and the wound of the prostatic capsule and of the body wall is allowed to heal per primam.

Surgical Technic. The operative approach is identical to that presented by Millin for retropubic prostatectomy. This has been presented in detail in previous publications and will be reviewed briefly.

A low transverse suprapubic skin incision is made and carried down to the rectus sheath. The sheath is divided transversely and the rectus muscles separated in the midline. The bladder, which has previously been emptied by catheter, is palpated and the loose areolar tissue in the space of Retzius is gently swept cephalad. Three-bladed retraction is then applied and the prostatic sheath is inspected. In the case which presents prostatic hypertrophy we prefer the transverse prostatic capsular incision, but in children and in adults with other vesical pathologic disorders we use a vertical incision into the prostatic capsule. Prior to this incision the appropriate veins in the prostatic sheath are ligated or sutured so that bleeding is minimal at the time of section. The remaining bleeding points are dealt with individually.

If the obstruction is due to prostatic enlargement, the gland is then enucleated, cut free from the urethra and vesical neck and the prostatic arteries located and sutured. Smaller bleeding points in the vesical neck are electrocoagulated, and digital examination of the bladder cavity is made. Stone forceps are introduced and the stone is extracted. In no case to date has this maneuver been difficult.

If the obstruction is due to hypertrophied interureteric ridge, to median bar or to congenital valve, appropriate resection and hemostasis is performed, care being taken to remove all of the obstructing tissue. This is not difficult due to the excellent exposure obtained.

The entire operative area is then inspected and flushed free of detritus and such small clots as may have accumulated. A suitable catheter is introduced through the urethra into the bladder, and the cut edges of the prostatic capsule are approximated with a running suture of chromic catgut.

The rectus fascia is closed with interrupted sutures and the skin is approximated. A rubber tissue drain is laid near to but not touching the suture line in the capsule. This drain is shortened on the second day and is removed on the third.

TABLE 1

Patient	Age (Yr.)	Causative Pathologic Disorders	Post-operative Catheter Days	Post-operative Hospital Days	Diameter Calculus	Remarks
V. S.	73	Contracted vesical neck	4	9	5 stones, 3–4 cm.	Stones were located in huge diverticulum near vesical neck
J. P.	66	B. P. H.*	4	6	2 stones, 1.5 cm.	True lateral lobe enlargement
G. E.	71	B. P. H.*	4	7	2 cm.	
M. C.	67	B. P. H.*	7	9	3 stones, 2 cm.	
C. B.	76	B. P. H.*	6	9	5.5 cm.	Non-opaque (uric acid) calculus
J. B.	76	B. P. H.*	5	13	2.5 cm.	
M. R.	80	B. P. H.*	6	13	5 cm.	Stone lodged in prostatic urethra
J. F.	72	Fibrosis of prostate	6	10	2.5 cm.	Stone lodged in prostatic urethra
W. P.	9	Congenital fibrotic bar	4 7	19	0.8 cm.	Non-opaque stone; suprapubic leakage necessitated reinsertion of catheter
S. A.	53	Hypertrophied interureteric ridge	3	6	4 cm.	

* Benign prostatic hypertrophy.

The catheter is left in place for three to four days as a rule. The patient is allowed out of bed on the first or second postoperative day.

RESULTS AND CONCLUSIONS

A brief résumé of our patients who underwent retropubic vesicolithotomy is tabulated. (Table 1.)

The average postoperative hospital stay was 10.1 days, the shortest being six days and the longest nineteen days. The postoperative catheter drainage period averaged 5.6 days. All patients enjoyed an extremely benign postoperative course and the only temporary suprapubic urinary fistula occurred in an infant (W. P.). This fistula healed spontaneously after four additional days of urethral catheter drainage. The first patient (V. S.) required vesical neck dilatation to allow removal of the five large stones. In spite of the fact that this patient retained his large inoperable diverticulum his convalescence was without complication.

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RECTAL WASHINGS, TECHNIC FOR CYTOLOGIC STUDY OF RECTOSIGMOID*

A PRELIMINARY REPORT

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CARCINOMA of the rectum and anus was responsible for 9,558 or 5.3 per cent of deaths due to cancer of all types in the United States in 1945.[1] The importance of early diagnosis has been emphasized by MacDonald who presents figures from Connecticut.[2] She found that the five-year survival rate of carcinoma of the rectum and anus with remote metastases was 0.5 per cent, with regional involvement 13.5 per cent and with localized lesions only, 19.9 per cent, a difference of almost fortyfold.

With the publication of their monograph on vaginal smears in 1943, Papanicolaou and Traut[3] stimulated a widespread interest in the cytologic method in the detection of malignant neoplasms. It soon became apparent that the cytologic method was very useful in the examination of other body fluids and its application to urine sediment, sputum, gastric aspirates, bronchial washings and prostatic smears have been reported.[4–8] In reference to rectal carcinoma, however, the possibilities and potential benefits of cytologic examination have not yet been explored.

The reasons for this have been mainly technical. There has been first the difficulty of obtaining specimens free of fecal contamination which masks the cells. Secondly, there has been no adequate technic with which one could obtain a high percentage of satisfactory specimens. The difficulties have handicapped previous work and thus far we have been able to find only three references in the literature relating to the cytology of the rectum and anus. Hunter and Richardson were able to find malignant cells in rectal mucus after imbedding and sectioning the mucus.[7] MacKenzie and Hecht diagnosed a case of carcinoma of the rectum by means of a direct smear from a lesion seen on sigmoidoscopic examination[9] while Gladstone has reported a similar case using his "sponge biopsy" technic.[10]

In the Strang Prevention Clinic where all methods of early cancer diagnosis are given clinical trial and in cooperation with the Colon and Rectal Service, Memorial Hospital Center, a special effort was made to apply the cytologic method to rectal carcinoma. To be successful this required first and foremost the development of a technic which would be practical, simple to perform, give uniformly good specimens and be adaptable to routine use. We believe the method described later fulfills these requirements.

TECHNIC

The problem of fecal contamination of the specimen was minimized by performing the test in conjunction with the sigmoidoscopic examination. The usual preparation of the patients consisted of 2 ounces of castor oil the previous night followed with a hot soapsuds enema the next morning. Sigmoidoscopy was performed usually from two to five hours after the enema. In most cases this preparation resulted in very satisfactory conditions.

The principal features of our technic of rectal washing are to wash the rectal mucosa with normal saline; recover this mixture of saline, mucus and suspended cells by aspiration; centrifuge the specimen and prepare smears from the sediment.

For the washing and recovery of the specimen a simple but effective instrument was devised by one of us (R. A. L.). (Fig. 1.) This consists of a double lumened brass tube 11½ inches long made by soldering together two tubes of ⅛ inch inside diameter. The tip

* From the Kate Depew Strang Prevention Clinic, Elise S. L'Esperance, Director; Memorial Hospital Center for Cancer and Allied Diseases, New York City. Aided by grant from the New York City Cancer Committee of The American Cancer Society.

of one tube is set back ¼ inch and both tips are highly polished to prevent injury to the bowel. The shorter tube carries the saline solution while the longer is used to aspirate the specimen. The distal ends of the tubes are spread slightly apart and to each is attached by rubber tubing a 20 cc. test tube with a two-hole rubber stopper in which are inserted glass "elbows." An atomizer bulb is attached to the tube on the short side of the apparatus while the other side is connected to the suction pump usually used by proctoscopists. Ten cubic centimeters of saline are placed in the first test tube and the apparatus is ready for use.

In practice the rectal washing is performed in conjunction with the sigmoidoscopic examination. The area from which cells are desired is located with the sigmoidoscope. With the suction pump running the brass tube of the washing apparatus is passed through the sigmoidoscope and the forward tip is placed on the area. By squeezing the rubber bulb a stream of normal saline is directed on the mucosa. This is immediately aspirated into the collecting tube. This feature is especially important when the sigmoidoscope is in the depressed position and there is danger of the specimen's running out to the floor. After collection the apparatus is withdrawn and the collecting tube containing the aspirated specimen is removed. The aspirating side of the apparatus is flushed with a strong stream of tap water to remove material adhering to the walls. It is then ready for reassembly and reuse.

The specimen is now fixed, processed and stained according to Papanicolaou's method as follows:[4] without delay, an equal quantity of 95 per cent ethyl alcohol is added to the specimen and well mixed. As soon as possible the mixture is centrifuged at 2,000 revolutions per minute for thirty minutes. The supernatant fluid is discarded and smears of the sediment made on slides previously prepared with Mayer's albumin. When the specimen contains a scanty amount of sediment, two or three drops of the supernatant fluid are retained in the tube. The tube is then sharply agitated and a drop of the resulting suspension placed on each slide to be prepared. This is spread either with a wooden applicator stick or with the edge of a clean slide as one would spread a blood smear. As soon as drying commences at the edges the slides are slipped quickly into the fixing solution made up of equal parts of 95 per cent ethyl alcohol and ether. Just when to put the slide into the fixative is very important and is learned with experience. Too much drying injures the cells and makes interpretation difficult. If the slide is too wet, much of the specimen will be detached from the glass and lost in the fixing solution. After at least one hour's fixation the slides are stained with hematoxylin, OG 6 and EA 50 just as for vaginal smears.

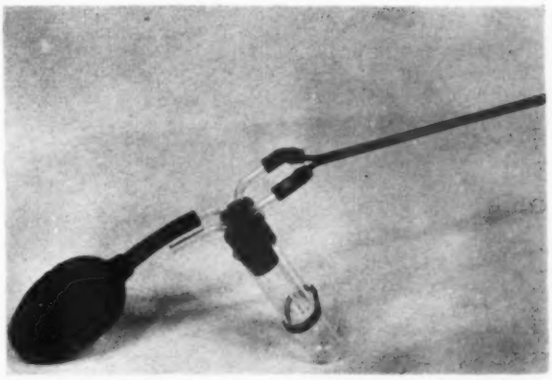

FIG. 1. Instrument to procure rectal washings. The 20 cc. test tube on the bulb side of the apparatus contains 10 cc. normal saline. A standard suction pump is attached to the glass elbow in the other test tube. Pressure on the bulb directs a stream of saline on the rectal mucosa. The washings are simultaneously aspirated and trapped in the collecting tube.

RESULTS

Since our primary purpose has been to develop a suitable technic and to determine the feasibility of rectal washings, we have, in this phase of the work, restricted our studies chiefly to known cases. So far we have carried out the procedure described before on 120 patients with and without rectal pathologic disorders. Pathologic conditions have included presence of bloody mucus, hemorrhoids, polyps, adenocarcinoma of the rectum, diverticulosis and ulcerative colitis. Most of the specimens have been very satisfactory, showing an adequate amount of material and excellent preservation of cellular structure. The specimens have been surprisingly free from fecal contamination. Isolated cells and cell clusters show good nuclear and cytoplasmic differentiation with a minimal amount of distortion.

While our experience with rectal washings is still too limited to venture a discussion of the cytologic details, certain impressions may

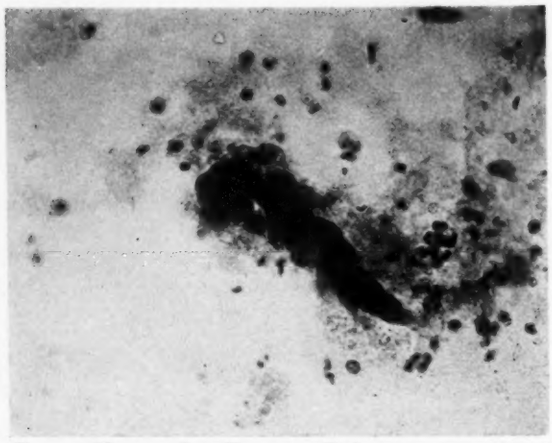

FIG. 2. Cluster of malignant cells in a smear prepared from rectal washing as described in the text. This is from a known case of adenocarcinoma of the rectum. × 400.

with thickening of the nuclear membrane. The chromatin forms a coarse network, clumping is common and enlarged and prominent nucleoli may be present. The cytoplasm is often reduced to a thin acidophilic rim whose borders are indistinct. In the cluster forms there is a loss of cellular pattern, crowding of the cells and overlapping of the nuclei. (Fig. 2.) The close similarity of these cells with those seen in histologic sections is illustrated. (Figs. 3 and 4.) Most of the washings from cases with benign pathologic disorders also showed considerable exfoliation. Specimens from cases in which polyps were found usually contained large numbers of normal cells, mainly of the columnar and mucoid types (Fig. 5), and frequently polypoid structures were seen. (Fig. 6.)

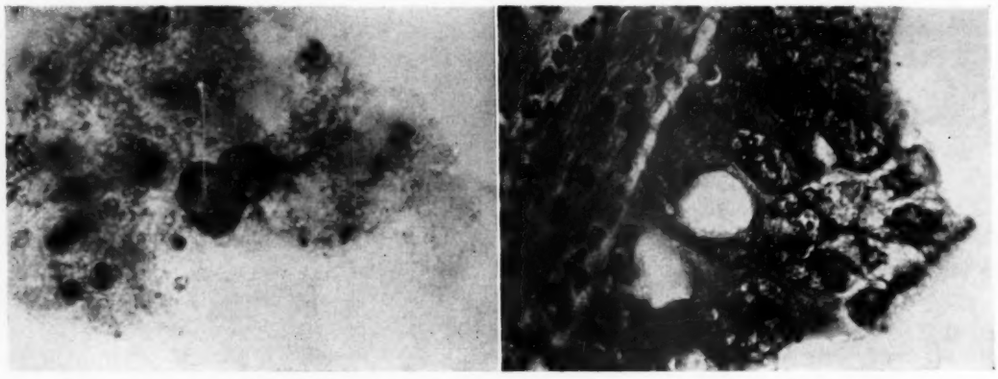

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FIG. 3. Two malignant cells in a rectal washing from a case of adenocarcinoma of the rectosigmoid. Note the nuclear enlargement, hyperchromatism and prominence of the nucleoli. Indication of size can be gained by comparing with the polymorphonuclear leukocyte at lower left of the picture. × 800.

FIG. 4. Histologic section from the rectosigmoid adenocarcinoma illustrated in Figure 3. Note the close similarity between these malignant cells and the exfoliated cells recovered in the rectal washings. × 800.

be mentioned. Smears prepared from specimens of cases that were clinically negative as a rule contained only a small number of exfoliated normal cells. Most encouraging is the fact that adenocarcinoma of the rectum undergoes a profuse exfoliation. In practically all our washings from these malignant cases we were able to find numerous cell clusters with distinctly malignant characteristics. These cells were found in isolated and cluster forms. In the isolated malignant cells the nuclei are disproportionately enlarged in relation to the cell. The outline of the nucleus is usually oval, but lobulated and irregular forms are also seen. There is marked hyperchromatism

In conjunction with the rectal washings we have also made direct smears in many cases. These proved to be very useful when visible lesions were present and such contact smears have made satisfactory preparations.

COMMENTS

In describing this as a simple technic we must, of course, qualify the term. This method can thus far be used only in conjunction with sigmoidoscopy. While passing a sigmoidoscope is by no means a formidable procedure, it certainly cannot be classed with the insertion of a vaginal speculum nor is it to be under-

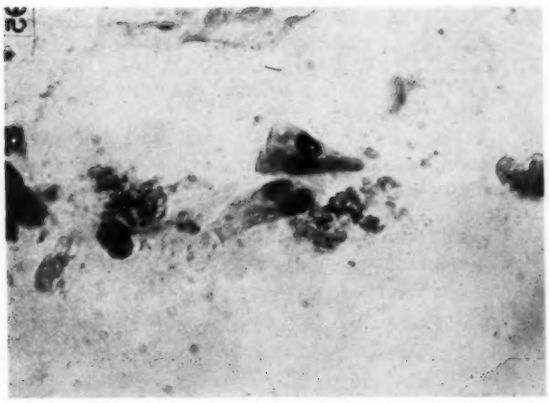

FIG. 5. Columnar epithelial cells in a rectal washing; these are frequently seen in normal cases and in an excellent state of preservation. × 400.

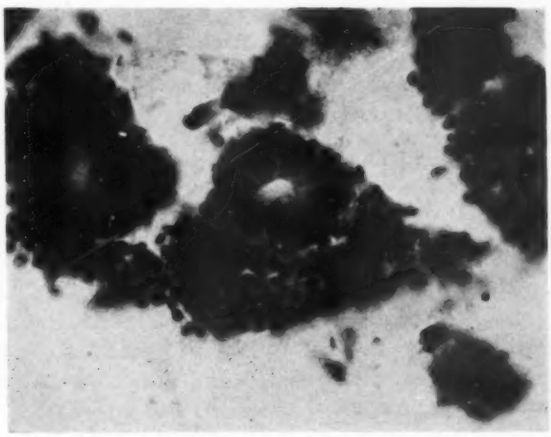

FIG. 6. Polypoid clusters seen in a rectal washing. This is from a patient in whom a rectal polyp was demonstrated. × 400.

taken by anyone not well experienced in its use. In Strang Clinic where sigmodoscopy is a routine procedure in all patients over forty-five years of age and in all patients with lower bowel symptoms, the rectal washing very easily becomes a part of this examination. As more physicians become expert in the use of the sigmoidoscope and as sigmoidoscopy becomes more and more a part of a routine physical examination, the necessity of combining the washing with a specialized procedure will become less objectionable.

As with any laboratory technic, careful attention must be paid to the details of the collection and preparation of the specimen. Considerable and experienced judgment must be exercised in the interpretation of the smears.

We have no definite conclusions as to the accuracy of our technic as yet since we have used it mainly in known cases, nor can we state how great an area of the colonic mucosa is represented by the cells seen in our specimens. If cells from the right colon can be recovered in rectal washings, such preparations may have great value. On the other hand if our washings pick up cells only in the immediate vicinity of the end of the sigmoidoscope, its application will be limited. We are now applying the rectal washing technic more extensively to find answers to the aforementioned. We hope in describing our technic to encourage others to test the usefulness of this method.

SUMMARY

1. A technic and apparatus used for obtaining satisfactory rectal washings is described.

2. Specimens were satisfactory and smears prepared from them contained few contaminants.

3. A survey of the cases examined so far indicates that adenocarcinoma of the rectum exfoliates well and that such exfoliated cells may be recognized in smears prepared from rectal washings.

4. No discussion of the accuracy of this method is given since most of the cases in this group were of known malignancy. A more intensive study of this method is now being carried on to determine its accuracy in the diagnosis of malignant neoplasms of the lower bowel.

Acknowledgments: We are indebted to George N. Papanicolaou, M.D., Consultant to the Cytology Laboratory, who reviewed the smears included in this study. We are also indebted to Dr. Michael R. Deddish, Associate Attending Surgeon, Colon and Rectal Service, Memorial Hospital Center, through whose cooperation we were able to obtain our specimens from known cases of rectal carcinoma.

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In patients with pulmonary arteriovenous aneurysms congenital and mechanical defects are present between the arteries and veins in some portions of the lung field. Medical therapy is of no avail but lobectomy or other similar procedure that removed the involved lung area is followed by a successful result in almost all patients. W. L. Watson reports two successful cases. In one a lobectomy was done; in the other he found, doubly ligated and severed, an aberrant artery springing from the thoracic aorta. With elimination of this artery the lung condition seemed to disappear. At any rate no mass was palpable; hence no lung tissue resection was considered indicated and none was done. The patient did well. We are certainly making great strides in the fields of thoracic and vascular surgery. (*Richard A. Leonardo, M.D.*)

DÜHRSSEN'S INCISIONS*

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FROM the years 1922 to 1949 there have been fifty-seven patients delivered following the use of Dührssen's incisions at the Methodist Hospital in Brooklyn, with one maternal death and eight stillbirths. During the same period there have been 61,490 delivered making a ratio of one Dührssen incision to 1,078 deliveries.

In the year 1890 Dührssen[1] described the use of cervical incisions as an aid to delivery. He made two or three incisions, two lateral and possibly one posterior sufficient to dilate the external os completely. He also stated that with the use of an antiseptic these incisions were absolutely without danger. Many of the deliveries were not difficult and he did not consider the procedure "acouchment force." Our technic differed from his only in the fact that we incised the cervix obliquely, that is at ten and two o'clock. Incisions were seldom made at six o'clock. In the great majority of cases only the vaginal part of the cervix was incised and due to this fact repair is simple and hemorrhage is slight.

At the present time so much stress has been given to cesarean section for the delivery that many of the procedures which were previously used have possibly been neglected. Among these may be mentioned high or medium forceps, bag inductions, artificial rupture of the membranes and Dührssen's incisions.

Now with the use of vaginal antiseptics during labor and at the time of delivery we have little to fear as far as puerperal infection is concerned. The antibiotics and the extraperitoneal cesarean section have also been of benefit. Postpartum hemorrhage which has been given credit for almost as many deaths as infection is not to be dreaded as in the past because of the availability of massive blood transfusions if necessary.

The fifty-seven cases have been analyzed showing that there were forty-seven private cases with a morbidity of 17.1 per cent and no maternal deaths and on the ward service there were ten cases with a morbidity of 70 per cent and one maternal death. Forty-nine of the patients were primiparas with a morbidity of 26.5 per cent and there were eight multiparas with a morbidity of 25 per cent. One of the most difficult deliveries was in a gravida 8 with seven living children. (Case 11.) The position of the baby was posterior in thirty-nine, occiput transverse in seven of the patients, fourteen were anterior and there were four breeches. The posterior position seems to be the principal cause of cervical dystocia. If it were possible to correct this position as recommended by Pomeroy, or if we were to do a Dührssen's incision, there is little doubt but that a considerable number of these patients would deliver easily if they were allowed to continue in labor.

There were thirty-five medium forceps, twelve high medium and four high forceps. With the posterior position the head is unable to descend when the cervix is not fully dilated and thus, if these patients are to be delivered from below, it is necessary to do a median or a high median forceps. There were twelve of these patients who were delivered with the use of Barton forceps which makes it very easy to get a correct application, and the rotation of the baby's head to the anterior position is usually a simple procedure. Frequently the delivery can be completed with these forceps, but there are times when it is preferable to change to a Simpson forceps after the position is corrected. Then by using the traction bar the baby is delivered. Kielland forceps were used in several cases but do not seem to be fitted to such a delivery. Two babies were lost following the use of the Kielland forceps as well as the one mother.

There were four babies delivered by version two of which had a prolapsed cord. The placenta was removed manually eight times. This is important so that at the same time the possibility of a ruptured uterus may be ruled out following a difficult delivery. Forty-three of the patients were examined vaginally; fourteen once, ten twice, sixteen three times and one eleven times. The membranes were ruptured in eight patients from ten to twenty

* From the Obstetrical Department of the Methodist Hospital, Brooklyn, N. Y.

hours, in seven patients from twenty to thirty hours, in seven patients thirty to forty hours, in two forty to fifty hours, in four fifty to sixty hours and in nine over seventy hours. In ten patients the time of rupture was not recorded.

There were eight patients in labor less than ten hours, seven were in labor ten to twenty hours, twelve twenty to thirty hours, eleven thirty to forty hours, three forty to fifty hours, six fifty to sixty hours and six were in labor more than sixty hours. In one the duration of labor was not recorded.

Maternal Morbidity. There were fifteen patients who had a morbidity of two or more days, a percentage of 26.3. Ten of the patients had a morbidity of five days or less and these were discharged either on the regular day or within three days of it. Five of the patients had a morbidity of seven days or longer. They all had posterior positions and three had very difficult deliveries. Two patients had a morbidity of ten days. One of these patients had a rise in temperature to 101°F., but after five days it was normal and remained so until the fourteenth day when it reached 104°F. and again it was normal after three days. She remained in the hospital for thirty-five days and the diagnosis was phlebitis and a mastitis. The second case had a morbidity of ten days and had had the membranes ruptured for thirty-four hours and was in labor for eighty-eight hours. She had a very difficult high forceps delivery and the baby weighed 9½ pounds. Her temperature reached 102°F. on two days and she was in the hospital for twenty days. She was given two transfusions and the cause of the morbidity was pyelitis. Her urine was loaded with pus cells. Included among those with a morbidity was the mother who died and her history is given in Case 1. The total days' morbidity for the fifteen patients was seventy or 4.6 days per patient.

When we consider the three most frequent causes given for maternal morbidity are ruptured membranes, long labors and vaginal examination, it is surprising that with forty-four of the patients being examined vaginally thirty-six were in labor more than twenty hours and forty-five had the membranes ruptured more than ten hours. Only five of the fifty-seven patients had a morbidity of more than five days.

Infant Mortality. There were fifty-nine infants delivered following the use of Dührssen's incisions. There were two sets of twins, eight stillbirths and no neonatal deaths. Forty-seven of the infants were of forty weeks' gestation or over, four were thirty-nine weeks, six were thirty-eight weeks and two under thirty-eight weeks. Eight of the babies weighed less than 7 pounds, twelve between 7 and 8 pounds, sixteen between 8 and 9 pounds and six between 9 and 10 pounds. There were eight babies lost of which six were of forty weeks' gestation, one thirty-nine weeks and one forty-three weeks. Four of the babies were on the ward service giving a mortality of 40 per cent. There were four deaths on the private service among forty-seven babies, a mortality of 8.7 per cent.

Three of the babies were macerated at birth, two of these had craniotomies and of the five remaining, in three, the delivery was attempted before the cervix was incised. One set of twins was lost. The delivery was easy but the mother was pre-eclamptic and this probably accounted for their death. The autopsies were negative. It would seem possible that two of the babies might have been saved if the cervix had been incised before the delivery was attempted. There is no doubt but that cesarean section would have been advisable even after attempting forceps.

CASE REPORTS

CASE 1. No. 29901. Mrs. A. G. was a twenty-nine year old gravida 1 weighing 210 pounds. She had a justomajor pelvis which was confirmed by x-ray with no numerical dystocia. This patient was admitted to the hospital on August 17, 1944, with the membranes ruptured and having slight irregular pains. The head was not engaged. The patient continued in labor for ninety-six hours and the membranes were ruptured for 109 hours. At this time the cervix was almost fully dilated and the head dipping into the brim of the pelvis. Two hours before delivery the patient was given morphine sulphate ⅙ gr. and scopolamine 1/150 gr. The patient was prepared for delivery and under nitrous oxide and ether anesthesia Barton forceps were applied to the head which was in the right occiput transverse position. When traction was made, it was believed that delivery per vagina would be very difficult and the patient should be sectioned. However, another consultant was called and he decided that the dystocia was due to a contraction ring and

that the patient should be delivered from below. The patient was given 1 cc. of adrenalin with subcutaneous injection, Kielland forceps were applied and delivery seemed impossible. The cervix was then incised and delivery completed with considerable difficulty. A right mediolateral epesiotomy had been done. The baby was stillborn and weighed 8 pounds, 10 ounces. The child's death was due to asphyxia or possible cerebral injury. There was considerable laceration of the vagina, but the cervical incision was small. The placenta was easily expressed and the blood loss did not exceed 400 cc.

Immediately following delivery the patient went into shock and she was given artificial respiration, oxygen and adrenalin. She received 500 cc. of plasma and seemed to respond well. She was visited by her husband and while talking to him was getting a transfusion of citrated blood; and when 350 cc. had been administered, the patient suddenly became cyanotic, gasped for breath and died in a few minutes, apparently from an embolus. The cavity of the uterus was explored post mortem and no evidence of rupture was found. Autopsy was refused.

There is no doubt but that this mother should have been sectioned when it was found that delivery was going to be difficult by the vaginal route.

Case II. No. 12564a. M. H., a gravida 8 with seven living children, was admitted to the Methodist Hospital on June 6, 1936. She had short labors and the fifth child was stillborn two weeks before term. After eighteen hours of good labor the cervix was only four fingers dilated and the head was wedged into the brim of the pelvis in the right occiput posterior position. The cervix was markedly edematous, the posterior rim about 2 inches thick. Under nitrous oxide and ether anesthesia the cervix was dilated as much as possible. Kielland forceps were applied and delivery attempted. Barton forceps were also applied without success. The cervix was then incised and delivery completed without difficulty using the Barton forceps. The baby was stillborn and a large tumor was present in the baby's abdomen which extended down to the umbilicus. At autopsy this proved to be a very large liver weighing 340 gm. The diaphragm extended straight across the abdominal cavity with no upward concavity. The microscopic examination resembled that of a premature liver. This baby would very likely have died had it been delivered by cesarean section.

The cervix was repaired following delivery and the mother's condition was fairly good. She was given an infusion of 500 cc. of 10 per cent solution of glucose and later a transfusion of 500 cc. of citrated blood. She had a seven-day morbidity; the highest temperature was 102°F. except following a transfusion which was given on the eighth postpartum day when it rose to 105°F. The temperature returned to normal by the tenth day. She went home on the sixteenth day. The morbidity was very likely due to the cervix. A large mass of cervical tissue sloughed off on the thirteenth day after delivery.

Case III. No. 28545a. Mrs. M. B. was a gravida 2, para 1 and thirty years old. She had a normal delivery in 1943 of a child weighing 9 pounds 4 ounces. She was admitted to the hospital on June 26, 1948, being one week overdue and had been vomiting throughout her whole pregnancy. This condition was considerably worse during the last two weeks. On the day following admission a No. 3 bag was inserted into the uterus without rupturing the membranes. The bag came out in three hours at which time the membranes were ruptured artificially and a prolapsed cord was found. The cord was replaced, Simpson forceps were applied and one deep incision made in the cervix at ten o'clock, and the baby was easily delivered. The baby weighed 8 pounds, 9 ounces, and its condition was good. At the upper angle of the incision in the cervix there was some active bleeding which was easily controlled with interrupted sutures. The patient's condition was fair at the time of delivery. She was given 1 unit of plasma and 500 cc. of citrated blood. She had no morbidity and was discharged from the hospital on the eighth day. Six weeks following the delivery of the baby the cervix was nicely healed. It would have been better perhaps to have made an anterior incision, separating the bladder as is done in a vaginal hysterotomy. If several small incisions had been made, it would not have allowed the baby to be delivered. If one had waited for a cesarean section, the baby might have been lost.

Case IV. No. 36495. O. S. was a gravida 2, para 0 and twenty-nine years old who had had a miscarriage in 1947. She was admitted to the hospital on November 14, 1948, in mild labor. After the patient had been in labor for

nineteen hours, the cervix was only three fingers dilated. A No. 4 Voorhees bag was inserted through the cervix. The bag came out in one and a half hours and the cervix was then four and a half fingers dilated and three hours later it was just the same. At this time delivery under spinal anesthesia seemed indicated. The baby was in the right occipito-posterior position, Barton forceps were applied, the position corrected and after incising the cervix at ten and two o'clock, the baby was easily delivered by high median forceps following a right mediolateral episiotomy. The placenta was removed manually; the cervix and the perineum were repaired. The mother's condition was good. She was discharged from the hospital on the eighth postpartum day and at the end of six weeks the cervix was healed with primary union. The condition of the baby was good at birth. It was given 20 cc. of maternal blood by a cord transfusion as a prophylactic measure to prevent any cerebral damage from the long labor. The baby weighed 9 pounds, 4 ounces and was almost up to its birth weight when it was discharged from the hospital.

This patient might easily have had a cesarean section, but she is certainly better off now than if she had had an abdominal delivery.

COMMENTS

With the use of vaginal antisepsis during labor and at the time of delivery, the use of antibiotic drugs and finally the use of the extraperitoneal cesarean section, one should not hesitate to give a patient a good test of labor or even to attempt delivery from below. If it is found too difficult, a cesarean section should be done.

There are many well qualified obstetricians who would hesitate to do a Dührssen's incision; in fact, many would even hesitate to do a bag induction, a high or median forceps and would do a cesarean section without doing a vaginal examination or even rupturing the membranes in order that the patient may have a real test of labor. In my own private service and on the ward where I have been active for thirty-five years it is very seldom that a real disproportion is found to exist. This is borne out by the fact that twenty-six of the fifty-seven patients who had Dührssen's incisions were either on my service or were seen by me in consultation.

SUMMARY*

1. Fifty-seven patients were delivered following the use of Dührssen's incisions with the loss of one mother, eight stillbirths and no neonatal deaths.

2. The loss of the one mother was due to poor judgement used at the time of delivery. The patient should have been sectioned when delivery by forceps proved to be difficult.

3. Three of the babies were macerated among the stillbirths and in three delivery was attempted without doing a Dührssen's incision. When delivery was found impossible, the cervix was incised. The two remaining babies were a set of twins; the delivery was easy and the autopsy was negative. The mother was pre-eclamptic which might have accounted for their death.

4. The morbidity of the fifty-seven mothers was 26.3 per cent and the total number of days' morbidity was seventy, an average of 4.6 days for each of the fifteen mothers with a morbidity. Only two of the patients had a morbidity of as long as ten days. One of these had mastitis and phlebitis, and the other had a diagnosis of pyelitis. Her urine contained much pus.

5. The occipitoposterior position with a large baby is the principal factor in cervical dystocia as it is generally called; some will prefer the term uterine inertia.

6. Four case histories are presented, namely, one of a mother who was lost; one in which the baby had a very large abdominal tumor which proved to be an enlarged liver and two which might have been sectioned, but the results proved that the patients were better off with a vaginal delivery.

7. The use of cesarean section has been stressed so much of late that many patients are operated upon who could be very easily delivered from below following Dührssen's incisions.

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* During the year 1950 three additional patients have been delivered following Dührssen's incision with excellent results. One was a breech in which the cervix was incised when it was found that the aftercoming head could not be delivered without using too much force. In one of the other cases a cesarean section seemed necessary; but after the head had been rotated manually and the cervix incised, delivery was easily completed.

CANCER OF THE CERVIX DIAGNOSED BY SPONGE BIOPSY*

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THE method of sponge biopsy recently introduced[1,2] and applied to the diagnosis of cancer in a wide variety of accessible sites[3–6] has yielded results. These imply a special competence in the diagnosis of cancer of the cervix uteri, not only in cases which are clinically manifest by the presence of bleeding and ulceration, but also in the early cases in which clinically there is neither sign nor symptom pointing to the presence of the disease. The gravity and frequency of this disease and the simplicity of the method offered for its diagnosis have prompted us to apply the method of sponge biopsy to the examination of the cervix uteri in a series of 641 women. The technic† used has been previously described; the results are given in the present report.

PATIENTS AND SPECIMENS

Of the 641 patients who were the subjects of this study, 242 were hospital patients, 256 were seen in the outpatient department and 143 were private patients seen in the offices of physicians on our staff. Approximately 10 per cent of the total group were colored, 25 per cent Jewish and over 90 per cent parous. Almost 400 of our patients were between the ages of thirty and forty-nine with the following distribution by decades. (Table 1.)

TABLE 1
DISTRIBUTION OF PATIENTS ACCORDING TO AGE

Age	No.
10–19	1
20–29	88
30–39	161
40–49	234
50–59	96
60–69	24
70–79	6
Age not recorded	31
Total	641

In 305 cases additional tissue subsequently obtained for microscopic examination was available as follows: uterine curettings, 50; supracervical hysterectomy, 66; operative surgical specimen including cervix, 78; surgical biopsy of cervix, 111. In 189 cases, therefore, the microscopic findings in sponge biopsy of the cervix could be compared with those of surgical biopsy or surgical operative specimen.

MICROSCOPIC FINDINGS

Sponge biopsy of the normal cervix will show on microscopic examination stratified squamous cervical epithelium in individual cells, cell groups and tissue particles, the amount varying somewhat with the type of sponge used and the pressure with which it is rubbed. In the cervix both the gelatin and cellulose sponges yield satisfactory results. The cellulose sponge being somewhat firmer and having more abrasive action will usually gather more tissue for examination. From the normal cervix a variable amount of mucus with enmeshed polymorphonuclear cells is obtained in addition to the tissue. The sponge inserted into the external os often gathers mucous columnar cells individually, in groups and as small tissue particles showing some of the normal glandular pattern. In the normal cervix little or no blood is seen on sponge biopsy. The presence of blood may be related to menstrual flow, abnormal bleeding from the fundus uteri, abnormal hyperemia or friability of the cervical tissue, cervical polyp, erosion, ulcer or cancer.

In chronic cervicitis the sponge will include an abundant mucopurulent exudate. Many of the epithelial cells instead of being of the flattened stratified type will be more spherical

† The gelatin sponge (gelfoam No. 12) was made available by the Upjohn Company, Kalamazoo 99, Michigan. The cellulose sponge (Onkosponge No. 1) and the sponge biopsy forceps were made available by Histomed, Inc., Paterson 1, New Jersey.

* From the Department of Pathology, New York Polyclinic Medical School and Hospital. Aided by a grant from the Upjohn Company. These results were presented before the Joint Meeting of the Northeastern Region of College of American Pathologists and New York Pathological Society, December 3, 1949.

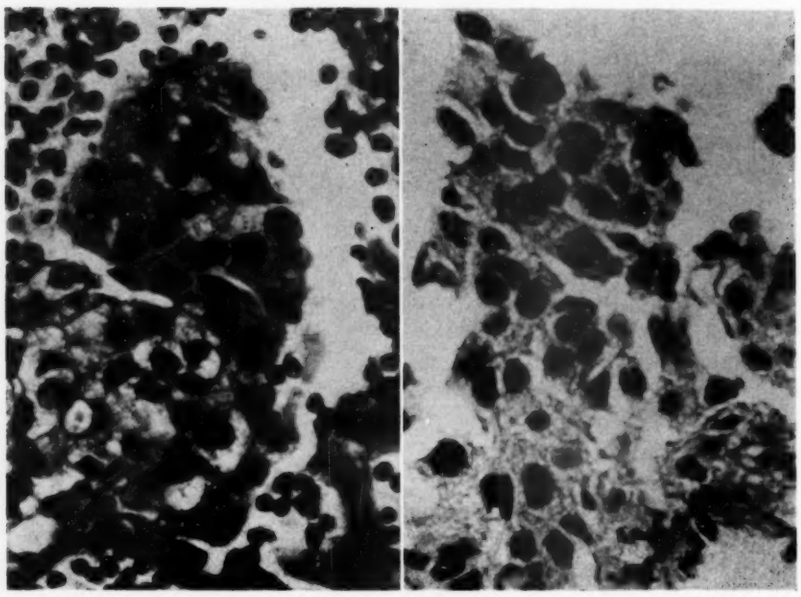

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FIG. 1. Sponge biopsy, high power, epidermoid carcinoma of cervix (Case 321); note particle of cancer tissue made up of cells with large round, oval and irregular nuclei showing considerable variation in size and shape. Around the margins red cells are present. A small piece of gelatin sponge is seen in the lower right hand corner.

FIG. 2. Surgical biopsy, high power, same case as Figure 1. The field is chosen from the margin of the section. The appearance of the cells and the complete loss of organized tissue pattern are the same in the surgical biopsy (Fig. 2) and in the sponge biopsy. (Fig. 1.)

in form with larger nuclei apparently arising from the middle zone of the mucosa showing incomplete differentiation. Small particles of cervical polypoid tissue covered on three sides by cuboidal cells are often removed by the diagnostic sponge. Tissue particles from the deeper layers of the mucosa may be numerous and show moderate degrees of cellular variation as to nuclear size and shape. The microscopic information thus gathered by sponge biopsy will permit a diagnosis of chronic endocervicitis with atypical epithelial hyperplasia and polyp formation.

In the presence of typical ulcerating cervical cancer the sponge (Fig. 1) will contain necrotic, inflammatory, hemorrhagic and neoplastic tissue. The cancer is seen in the form of individual cells, groups of cells and particles of tissue, the last sometimes 1 mm. in diameter and visible on the stained slide by direct inspection. Microscopically the cancer cell nuclei are large, darkly staining, show considerable variation in size and shape and occasional mitoses. The diagnosis of cancer of the cervix in these cases by means of sponge biopsy should be unequivocal. If the pathologist entertains any doubt, the best procedure is to repeat the sponge biopsy making sure to gather enough material in the sponge. In the beginning it is advisable in most cases to confirm the sponge biopsy diagnosis of cervical cancer by surgical biopsy (Fig. 2) prior to instituting treatment. This will safeguard the patient and help to enlarge the pathologist's experience in the application of a new method.

Adenocarcinoma of the cervical canal, even in the early stage before the onset of sign or symptom, may be diagnosed by the demonstration of characteristic atypical glandular tissue and groups of atypical cuboidal and columnar cells in the sponge (Figs. 3 and 4) which has been inserted into the cervical canal and which has gathered tissue particles from the lesion of the mucosa.

Early superficial carcinoma of the cervix (i.e., carcinoma *in situ*, intra-epithelial carcinoma) presents a different picture. These lesions are usually without sign or symptom. The sponge biopsy shows characteristic particles of cancer tissue (Fig. 5) removed from

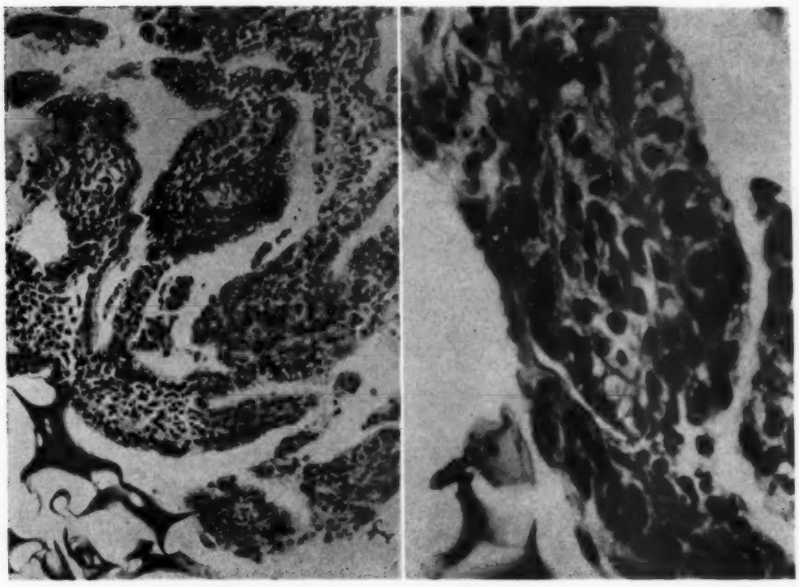

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FIG. 3. Sponge biopsy, low power, adenocarcinoma of cervical canal (Case 1095); note the abnormality of the glandular pattern and the proliferation of epithelial cells.

FIG. 4. Same as Figure 3, high power; note the enlargement of the epithelial cell nuclei, with marked variation in their size and shape.

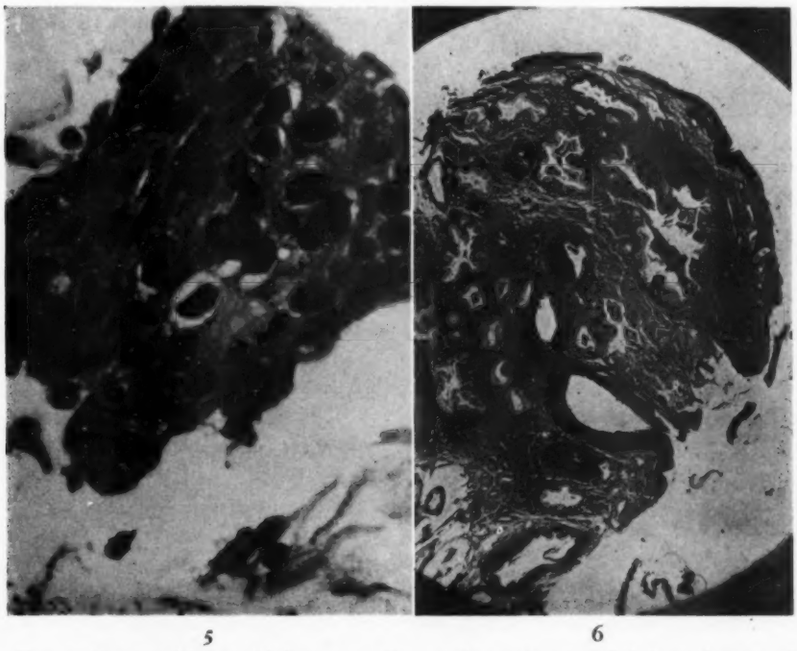

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FIG. 5. Sponge biopsy, high power, Case 1062, early superficial carcinoma of the cervix. The cell nuclei are large, darkly staining, show marked variation in size and shape. Normal stratification and differentiation are lost. A small piece of cellulose sponge is seen in lower right.

FIG. 6. Surgical biopsy, very low power, same case as Figure 5; the superficial carcinoma is seen as a dark zone of closely packed cells covering the surface and extending into the lumina of the mucous glands, at times completely filling them and replacing the lining of mucous cells.

TABLE II

SIXTEEN CERVICAL CANCERS FOUND POSITIVE BY SPONGE BIOPSY AMONG 641 WOMEN

Case No.	Age (yr.)	Final Diagnosis	Diagnosis Established by	Comment
2	50	Epidermoid carcinoma of cervix	Surgical biopsy	Bleeding 2 mo.
106	71	Epidermoid carcinoma of cervix	Surgical biopsy	Advanced lesion, grade IV
108	62	Epidermoid carcinoma of cervix	Surgical biopsy	Advanced lesion
156	56	Epidermoid carcinoma of cervix	Surgical biopsy	Spotting 2 yr.
321	50	Epidermoid carcinoma of cervix	Surgical biopsy	Vaginal bleeding 2 mo.
1082	43	Epidermoid carcinoma of cervix	Surgical biopsy	Vaginal bleeding 6 mo.
1118	52	Epidermoid carcinoma of cervix	Surgical biopsy	Spotting and bleeding 2 mo.
1333	44	Epidermoid carcinoma of cervix	Surgical biopsy	Continuous bleeding 6 wk.
1447	57	Epidermoid carcinoma of cervix	Surgical biopsy	Spotting for years; bleeding 3 mo.
1095	52	Adenocarcinoma of cervix	Surgical specimen	No symptoms referable to cervical carcinoma
1445	50	Adenocarcinoma of cervix	Surgical specimen	Early asymptomatic carcinoma; hysterectomy for prolapse of uterus
169	40	Early superficial carcinoma of cervix	Surgical specimen	Asymptomatic carcinoma; one surgical biopsy negative; four sponge biopsies positive
211	48	Early superficial carcinoma of cervix	Surgical specimen	One small (7 mm.) area of invasion, missed by surgical biopsy
399	39	Early superficial carcinoma of cervix	Surgical biopsy	Asymptomatic, anterior lip of cervix slightly bluish
1062	29	Early superficial carcinoma of cervix	Surgical biopsy	Eversion of anterior lip; 6 children, 9 pregnancies, four sponge biopsies positive
1169	35	Early superficial carcinoma of cervix	Surgical specimen	Asymptomatic; 6 children, 11 pregnancies; three sponge biopsies positive

the surface growth. (Fig. 6.) There is usually a striking absence of inflammatory, hemorrhagic or necrotic tissue.

In general the microscopic findings fall into one of three groups, namely, normal, inflammatory or neoplastic. The characteristics both cytologic and histologic in each group are usually sufficient to permit ready classification.

RESULTS

Sixteen cases of carcinoma of the cervix uteri were found among the 641 patients examined. (Table II.) There were nine cases of clinically suspected epidermoid carcinoma of the cervix associated with vaginal bleeding, visible ulceration of the lips of the cervix or actual palpable induration of the cervix and surrounding tissues. The remaining seven cases were clinically asymptomatic presenting neither symptom nor sign pointing to disease of the cervix. Of these seven there were two cases of early adenocarcinoma of the cervical canal and five cases of early superficial epidermoid carcinoma of the cervix, variously designated as carcinoma *in situ*, intra-epithelial carcinoma, preinvasive carcinoma, etc.

Relevant details with regard to the nine cases of epidermoid carcinoma of the cervix, clinically suspected, are given in Table II. Bleeding was present in all of these patients varying in duration from six weeks to six months and longer. Visible cervical ulceration or palpable induration or both were also present. The patients varied in age between forty-three and seventy-one, the average age being fifty-four years. In each case the diagnostic sponge presented on microscopic examination an abundance of cancer tissue easily recognized and diagnosed. The diagnoses were all confirmed by surgical biopsy and the

patients were treated by radium and roentgen ray therapy.

With regard to the seven asymptomatic cases of carcinoma of the cervix, the relevant data are presented in Table II. The two patients with adenocarcinoma of the cervical canal were fifty and fifty-two years of age, respectively. Both patients were treated by hysterectomy and the diagnosis was confirmed by microscopic examination of the surgical specimen. The five cases of early superficial or intra-epithelial carcinoma of the cervix form a very interesting and important group. They presented no bleeding, no spotting and little or no visible changes on the cervix suggesting carcinoma. They varied in age from twenty-nine to forty-eight years, the average age being thirty-eight. The sponge biopsies showed an abundance of characteristic carcinomatous tissue permitting a positive diagnosis in each case. In the three clinic cases during the period of observation a sponge biopsy was usually repeated during each visit to the clinic. These patients had four, four and three sponge biopsies of the cervix; each of the eleven was positive. In all five cases the diagnosis has been confirmed by surgical biopsy or surgical specimen. Four of these patients have been treated by total hysterectomy.

SUMMARY

Sponge biopsy, a method recently described for the diagnosis of cancer in accessible sites, has been applied to a study of the cervix uteri in 641 patients. Among the sixteen cases of cancer in this series nine presented clinical signs such as ulceration, bleeding, induration, etc. In seven cases there were neither signs nor symptoms. These included two adenocarcinomas of the lower cervical canal and five early superficial epidermoid carcinomas of the cervical lips. The findings in sponge biopsy were compared with the findings in surgical biopsies and surgical specimens of the cervix in 189 cases. Sponge biopsy of the cervix was positive for cancer in all cases in which cancer was demonstrated by subsequent examination of specimens obtained by surgical biopsy or at operation. In eleven repeated tests on three patients with early superficial cancer of the cervix, the sponge biopsies were all positive although in one of these cases the surgical biopsy was falsely negative. The long interval between asymptomatic superficial carcinoma and fully developed ulcerating lesions provides ample time for the detection and diagnosis of cancer of the cervix at a stage in which treatment offers an excellent chance of complete cure. Sponge biopsy is a simple and effective method for the diagnosis of cancer of the cervix not only in suspected and bleeding cases but also and especially in the early superficial carcinomas presenting neither sign nor symptom. It is not unreasonable to expect that a widespread use of sponge biopsy of the cervix in routine examinations will favor the early diagnosis and decrease the mortality rate of cancer of the cervix uteri.

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FISTULAS OF LACTIFEROUS DUCTS*

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THE purpose of this paper is to present the problem of chronic draining sinuses near the areola in the breasts of women, to discuss the probable pathogenesis of this condition and to suggest an effective method of treatment.

There is a large group of diseases of the breast characterized by dilatation of the larger ducts, stasis of secretion and periductal inflammation. These diseases have been variously termed "obliterative mastitis,"[9] "dilated ducts beneath the nipple" and "varicocele tumor of the breast,"[1] "comedomastitis,"[2,3,10–12] "plasma cell mastitis,"[5] "periductal mastitis,"[6] and "secretory cystic disease."[7]

Although the lesions of comedomastitis are well known, the presence of sinus tract formation complicating this lesion appears to be infrequent. Thus Tice et al.[11] describe only one case of draining sinus in their 172 cases of comedomastitis. Deaver[4] describes sinuses and fistulas of the female breast as complications of improperly drained acute pyogenic abscesses. He noted that abscesses appeared during pregnancy or lactation. Incision and drainage of these abscesses resulted in persistent draining sinuses which incited suspicion of underlying tuberculous infection. In nonpregnant women the cause was attributed to an "ancient" lactation abscess or mastitis. Dean Lewis[8] mentions occasional sinuses following "chronic pyogenic mastitis" and suggests that inadequate incision of an abscess may be the cause. The treatment advocated up to now is adequate drainage, sulfonamides and penicillin locally and parenterally, local excision of the sinus and even simple mastectomy when all therapeutic procedures failed to effect a cure.

Reports of five patients with comedomastitis in whom fistulas of lactiferous ducts developed follow:

CASE REPORTS

CASE 1. M. Z., a thirty-one year old white woman with three children, presented herself with draining sinuses in both breasts.

Two years previously, six months after the birth of her second child, a small abscess formed just lateral to the left areola. Spontaneous drainage occurred. One month later a similar abscess developed medial to the right areola. After incision and drainage both sinuses continued to drain intermittently. Nine months later the patient became pregnant and throughout the pregnancy drainage occurred from both breasts. An abscess developed again about the sinus in the left breast one week after delivery and required incision and drainage. Drainage occurred intermittently for two years from both breasts with several episodes of abscess formation.

When first seen at the Cleveland Clinic a draining sinus was present in each breast. Examination of the right breast revealed a small draining sinus just medial to the areola. Squeezing the breast produced a thick, yellowish, paste-like material from both the nipple and the sinus. The left breast showed a similar sinus lateral to the areola with a similar type of discharge. Conservative therapy was employed consisting of enlargement of the sinus openings with curettement of their bases, local and systemic penicillin, and wet dressings. The sinuses, however, failed to heal.

Under pentothal® anesthesia a No. 1 lacrimal duct probe was passed into the sinus tract of the right breast and emerged through a duct opening in the nipple. The tissue overlying the probe was incised in a radial manner and the involved duct excised. An identical procedure was done on the left breast. The wounds were left open.

* From the Naval Hospital, National Naval Medical Center, Bethesda, Md., and the Cleveland Clinic, Cleveland, O. The opinions and views set forth are those of the authors and are not to be considered as reflecting the policies of the Navy Department.

Pathologic examination of each specimen revealed a dilated, lactiferous duct lined by a thick layer of squamous epithelium. Within the dilated duct there was much loose keratinized epithelium. In the more distal portion of the duct there was erosion of the lining surface and infiltration by polymorphonuclear leukocytes. This inflammatory reaction involved the adjacent breast tissue with micro-abscess formation. In some areas about the duct there was extensive scar formation. In other areas there was a very heavy cellular infiltrate, chiefly plasma cells, but also lymphocytes and some polymorphonuclear cells. There was no demonstrable obstruction of the duct. The diagnosis was acute and chronic inflammation of lactiferous ducts with abscess formation.

Healing occurred in two weeks. No drainage was noted from either breast until fourteen months later when the patient delivered a seven month old stillborn baby as the result of premature labor with placenta previa. One week later a small sinus abscess developed about the scar in the left breast, requiring incision and drainage. Healing was prompt and no further drainage has occurred from either breast.

Case II. M. G., a twenty-nine year old white woman with two children, was seen with a draining sinus just medial to the areola of the left breast. The last pregnancy was five years before entry.

Three and a half years previously an inflammatory mass had developed medial to the left nipple. With the application of hot soaks the mass subsided but one year later recurred and was incised and drained. During the next six months an intermittent purulent discharge was noted from the drainage site. The incision closed and remained healed for eighteen months. At this time another abscess formed at the same site and was incised and drained.

When seen at the U. S. Naval Dispensary, Washington, D. C., a small sinus was noted just medial to the areola of the left breast. Drainage had been present for two months. A lacrimal duct probe passed easily into the sinus tract and emerged from the nipple. Under local anesthesia the tissue overlying the probe was incised and a dressing applied. The wound healed in ten days. When the patient was last seen, seven months later, there was no evidence of drainage. No tissue was available for pathologic study.

Fig. 1 Case III. Chronic draining sinus of breast at areolar border; note swelling between sinus tract and nipple.

Case III. E. T., a thirty-nine year old white woman with a nineteen year old son, first noticed a cyst-like swelling lateral to the right areola one year before entry. The area became inflamed and opened spontaneously two months later discharging a bloody, purulent material. Thick, creamy material continued to drain for the next four months. At that time she was admitted to a hospital and the sinus tract was excised.

Pathologic examination revealed breast tissue in which many of the larger ducts were dilated and lined by cuboidal epithelium. In one area the epithelium was hyperplastic and projected in the lumen as a papillary structure. Several of the ducts were dilated to cystic proportions and were lined with pale eosinophilic apocrine-like epithelium. There was a slight increase in interlobular fibrous tissue. Sections of the skin revealed ulceration in one area. About this area there was marked hyperplasia of the epithelium with elongation and broadening of the rete pegs. The diagnosis was chronic cystic mastopathy, intraductal papilloma and skin showing ulceration with acute and chronic inflammation.

The wound healed in two weeks but again discharged purulent material two months later. Drainage of a thick, greenish material continued for four months when the patient was examined and a sinus tract noted just lateral to the areola of the right breast. (Fig. 1.) Compression of the breast near the sinus opening produced a discharge of thick, greenish,

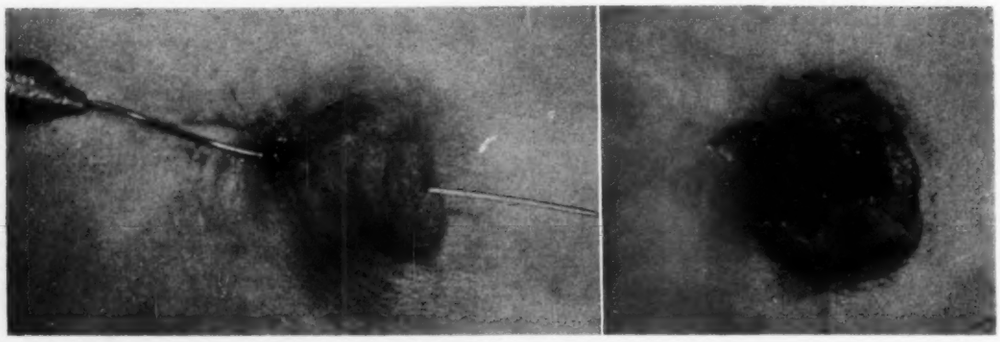

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FIG. 2. Case III. Fistula of lactiferous duct with lacrimal probe inserted.
FIG. 3. Same case. Immediate postoperative wound after excision of fistula.

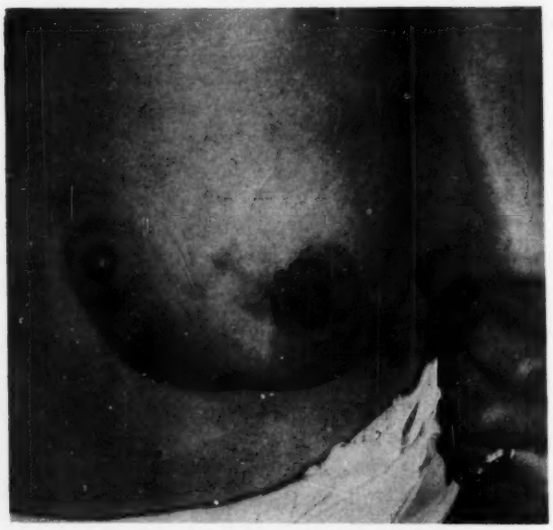

FIG. 4. Case III. Appearance of breast four months after excision of fistula; note minimal scarring.

purulent material from the sinus and from the nipple. Gentle probing of the sinus revealed a fistula. (Fig. 2.) Under pentothal® anesthesia the involved duct was excised over a fine probe along with the base of the sinus. Figure 3 shows the immediate postoperative wound.

Pathologic examination revealed skin, deep to which was a sinus tract. This sinus tract showed no epithelial lining. The lining of the tract consisted of vascular granulation tissue showing chronic inflammation. About the tract was a heavy infiltrate of plasma cells with a lesser number of polymorphonuclears and eosinophils. There were also a few hemosiderin-filled macrophages and foreign body type giant cells. The diagnosis was sinus tract showing acute and chronic inflammation. Healing was complete in two weeks and when last seen six months later had remained so. (Fig. 4.)

CASE IV. M. R., a forty year old white nulliparous woman, presented herself with a draining sinus of the left breast.

Seventeen years before an abscess developed in the left breast and was opened and drained. No further trouble occurred until six years before when an area of redness developed medial to the areola of the left breast but subsided in two weeks after treatment with hot packs. Three years ago a similar abscess was incised and drained. This procedure was repeated one year later.

When seen at the U. S. Naval Dispensary, Washington, D. C., a draining sinus was present medial to the areola of the left breast. Spontaneous drainage of a small abscess in this area had occurred two weeks previously. A fine probe easily entered the sinus and emerged from the nipple. Squeezing the breast produced a thick yellowish discharge. Under pentothal® anesthesia the involved duct in the left breast was excised over a probe and the wound left open.

Pathologic examination revealed a dilated lactiferous duct lined with a thick layer of squamous epithelium. Deep to the duct was an inflammatory infiltrate consisting chiefly of plasma cells but also of a few lymphocytes and leukocytes. The lumen contained desquamated epithelial debris. The diagnosis was acute and chronic inflammation of lactiferous duct. Healing occurred in ten days and six months later no drainage or induration had been noted.

CASE V. M. M., a thirty year old white woman with three children, entered the U. S. Naval Dispensary, Washington, D. C., with a draining sinus lateral to the areola of the right breast.

Two years before she noticed pain in the right breast and felt a small, tender lump just lateral to the areola. Four months later she became pregnant and stated that the mass increased in size toward the end of pregnancy. Four months after delivery the mass became fluctuant and was incised and drained.

When seen at the U. S. Naval Dispensary, Washington, D. C., a tiny sinus was noted lateral to the areola of the right breast. Drainage had occurred for a few days every two to three weeks for the past eight months. The areola between the sinus and the nipple presented a raised appearance and pressure over this area produced a thick, pasty secretion from the nipple. (Fig. 5.) Exploration of the sinus with a fine probe demonstrated a fistula of one of the lactiferous ducts.

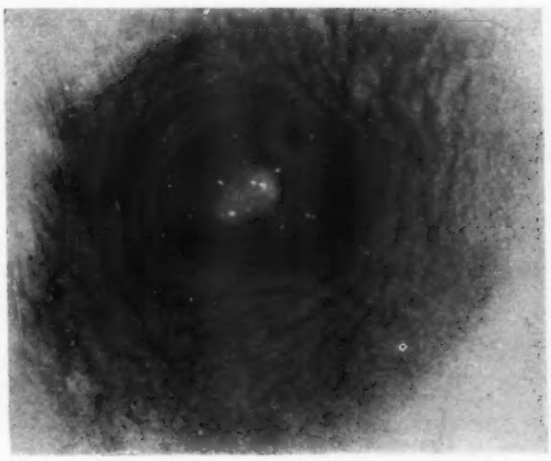

FIG. 5. Characteristic pasty secretion on pressure from the nipple in Case v; note the localized areolar swelling and the small sinus opening.

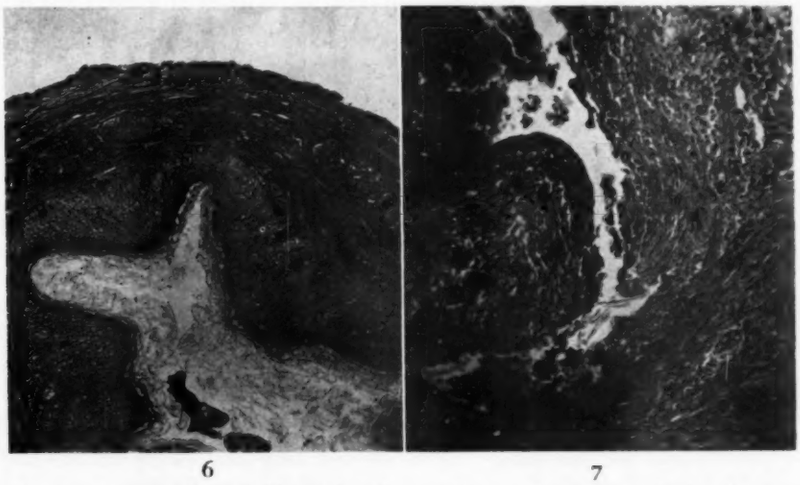

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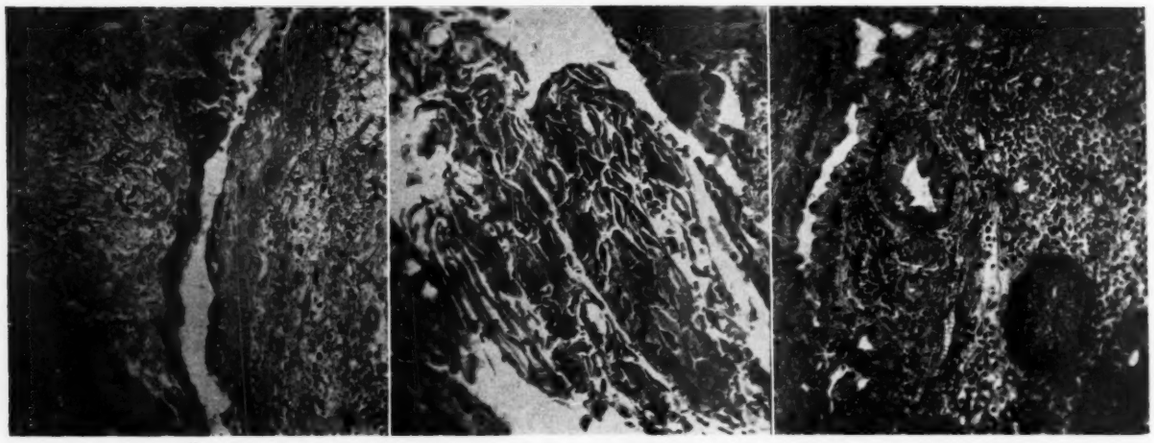
FIG. 6. Cross section of dilated lactiferous duct to show hyperplasia of squamous epithelium and desquamation of keratin scales into lumen. × 50.
FIG. 7. Lactiferous duct showing thinning of squamous epithelium and periductal chronic inflammation. × 200.

Under pentothal® anesthesia the tissue overlying the probe was incised. The base of the sinus was excised without removing the terminal portion of the dilated duct.

Pathologic examination of tissue from the base of the sinus tract showed a layer of edematous granulation tissue composed of new capillaries and fibroblasts. Within the granulation tissue there were chiefly fat-filled macrophages and plasma cells, but also a few polymorphonuclears and lymphocytes. In some areas there was hemorrhage from thin-walled capillaries, morphologic explanation for the origin of the sanguineous discharge seen in some of the patients. The adjacent breast tissue showed much fibroblastic reaction in the stroma with atrophy of the terminal ducts. The diagnosis was sinus tract with acute and chronic inflammation.

PATHOLOGY

The major microscopic findings are acute and chronic inflammation of a lactiferous duct accompanied with dilatation of the duct, stasis and desquamation of keratinized epithelium into the lumen. The lactiferous duct is dilated and lined for the most part by hyperplastic squamous epithelium. (Fig. 6.) However, in some areas the epithelium may be thinned or entirely denuded. (Figs. 7 and 8.) At the point



8 9 10

FIG. 8. Lactiferous duct showing point of ulceration of epithelium and infiltration of inflammatory cells into tissue. × 200.

FIG. 9. Detail of desquamated keratin scales in lumen of lactiferous duct.

FIG. 10. Breast tissue adjacent to lactiferous duct, to show infiltration by chronic inflammatory cells.

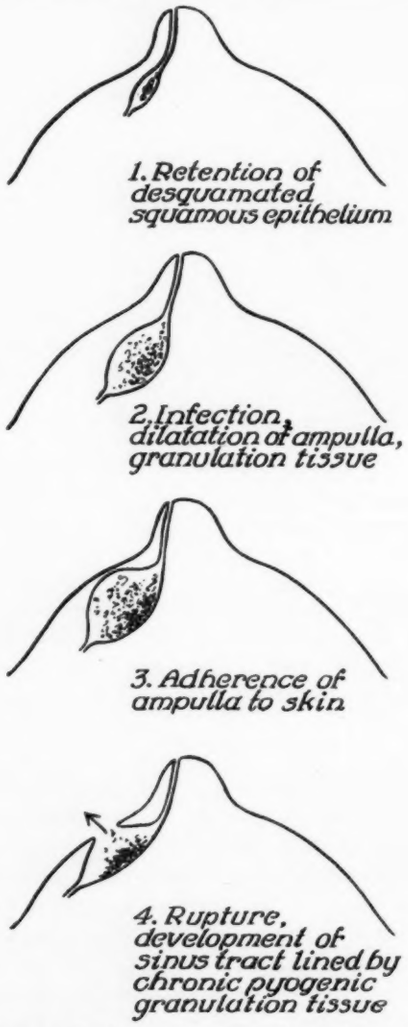

1. Retention of desquamated squamous epithelium
2. Infection, dilatation of ampulla, granulation tissue
3. Adherence of ampulla to skin
4. Rupture, development of sinus tract lined by chronic pyogenic granulation tissue

FIG. 11. Pathogenesis of fistulas of lactiferous ducts.

of ulceration there is a very heavy infiltrate of plasma cells, lymphocytes and polymorphonuclear leukocytes. The point of break-through of the inflammatory process appears to be in the ampullary portion of the duct rather than in the more distal portion of the duct. Within the dilated duct are flat scales of keratin derived from the lining squamous epithelium. (Fig. 9.) These keratin scales make up the paste-like secretion which can be expressed from the duct and constitute morphologic evidence of stasis within the duct.

The changes in the breast tissue about the duct vary considerably. Usually there is a great deal of scarring and evidence of chronic inflammation. (Fig. 10.) In other areas and particularly in the subareolar portion there may be a sinus tract lined by a pyogenic membrane. In Case III there was associated findings of chronic cystic mastopathy and small intraductal papillomas.

The pathogenesis of the lesions appears to be as follows (Fig. 11): (1) stasis of secretion within a lactiferous duct, (2) dilatation and infection in the region of the ampulla, (3) ulceration of the ductal epithelium with extension of the inflammation into the breast tissue, (4) the formation of a localized subareolar breast abscess and (5) rupture of the abscess through the skin with formation of an infected fistulous tract.

CLINICAL CONSIDERATIONS

Diagnosis is established by the presence of a draining sinus at or near the areola, a history of several abscesses that have occurred and the finding of a pasty discharge from the nipple

and occasionally from the sinus. Between the sinus and the nipple there is a prominence of the areola. This swelling represents the dilated duct with periductal inflammation. (Fig. 1.) Careful palpation beneath the areola in the radial direction of the sinus may reveal the presence of a soft, doughy, dilated duct which exudes the characteristic pasty secretion on pressure. (Fig. 5.) The material may exude from both the sinus and the nipple. Moderate tenderness is often present overlying the dilated duct. Palpation about the sinus reveals an area of induration and fixation which may incite a suspicion of underlying carcinoma.

Exploration of the sinus tract with a fine probe demonstrates the direction of the tract toward the nipple. Gentle pressure enables the probe to enter the involved dilated duct and emerge from the nipple. Repeated examinations result in emergence of the probe from the same point in the nipple each time. Figure 2 shows the breast in Case III with the lacrimal duct probe inserted into the sinus and emerging through the nipple.

TREATMENT

The term "fistula" is used in the title of this paper because of the similarity of the condition and its treatment to fistula-in-ano. The simple incision of the tissue overlying a probe passed into the sinus tract may be all that is required to affect a cure. This was done in Case II as an office procedure under local anesthesia. This method, however, does not completely excise the involved duct and a section of tissue is not obtained for microscopic examination.

Local excision of the sinus tract and its indurated base without removal or incision of the terminal portion of the involved duct results in recurrence of the abscess or in persistence of the drainage. This procedure was done in Case III and was followed with recurrence in two months.

The most effective treatment of fistulas of lactiferous ducts is excision of the terminal portion of the involved mammary duct along with the indurated base of the sinus. Excision of the duct is best accomplished over a fine probe inserted into the duct and out of the nipple via the fistulous tract. The proximal part of the duct need not be removed. The resulting wound is allowed to remain open. Figure 3 illustrates the immediate postoperative result in Case III. Experience with the five cases reported indicates that the wounds heal readily with minimal deformity of the nipple. Figure 4 shows the appearance of the breast in Case III four months after operation. Except for a minor episode occurring following a pregnancy in Case I there has been no recurrence of symptoms in the relatively short period that has elapsed since treatment.

CONCLUSIONS

1. Five cases of draining sinuses in the female breast are presented.

2. The pathogenesis of these draining sinuses is (1) stasis of secretion, (2) dilatation of lactiferous duct and (3) ulceration of ductal epithelium with abscess formation and rupture of the abscess to form a draining sinus.

3. The occurrence of fistulas of lactiferous ducts represents a complication of comedomastitis.

4. Excision of the sinus tract and the terminal (nipple) portion of the involved duct is a conservative and effective method of treatment.

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AMMONIUM SULFATE AS A LONG-ACTING ANALGESIC*

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THIS report concerns the infiltration of ammonium sulfate (dolamin) into postoperative surgical wounds, with a subsequent mild analgesic effect for several days.

For many years we have believed that control of postoperative wound pain would be effective in decreasing postoperative morbidity and possibly mortality, and in increasing patient morale. In recent years attempts have been made to control postoperative wound pain in upper abdominal wounds by injection of the intercostal nerves innervating the region of the incision. Gius[6] reported two cases of postoperative atelectasis which were successfully treated with paravertebral procaine block, wound pain being temporarily abolished, allowing active hyperventilation of the lungs and effective coughing. Zollinger[11] used a solution of eucupine and procaine in oil, finding a marked increase in vital capacity in the early postoperative period and decreased incidence of pulmonary complications compared to controls in a small series of cases. Starr and Gilman[10] used a similar solution for intercostal block anesthesia twenty-four hours following surgery and found that with the relief of upper abdominal wound pain the vital capacity was increased, the patient moved more freely, coughed and raised sputum more easily. Belinkoff[2–4] used a solution of monocaine, benzocaine and benzyl alcohol in oil for intercostal nerve blocks in upper abdominal operations. He attributed the high incidence of postoperative complications to wound pain and found that following intercostal nerve blocks respiratory excursions were increased and postoperative complications greatly reduced. He obtained anesthesia of the wound for eight to twelve hours and analgesia for two to three days in eighty-four of one hundred cases. McCleery, Zollinger and Lenahan[9] reported a series of cases in which they used nupercaine in oil for intercostal block. They found an increase in vital capacity and a decrease in pulmonary complications and narcotic requirements. Graham, Seldon, and Priestly[7] reported a series of cases in which dolamin was used for intercostal nerve block. They found that postoperative pain was not uniformly relieved to a significant degree in the majority of their cases and that there was no significant difference in the incidence of postoperative complications or narcotic requirements.

Crile[1] in 1918 attempted to produce local anesthesia of wounds by injecting a solution of quinine and urea hydrochloride locally into the wound. The anesthesia obtained was satisfactory, lasting several days, but frequently caused wound infection. Capelle[5] in 1935 attempted continuous administration of procaine solution locally into the wound area. He inserted several large hollow needles into the wound and injected procaine as was indicated. The solution was found to create toxic reactions and delayed wound healing, being discarded for these and technical reasons.

In 1931 Judovich[8] prepared an aqueous solution and later a distillate from the pitcher plant, observing that the preparation was of value in relieving pain of neuralgic origin. In 1935 he found that such action had no effect upon motor nerves or skin sensation. In 1949 Judovich and Bates[8] reported that the C fiber potentials of the saphenous nerve of a cat were obliterated without affecting other fibers of the nerve thus substantiating the belief of selective action of the pitcher plant distillate upon nerves. Chemical analysis showed the active principle of the pitcher plant distillate to be ammonium sulfate. Further study revealed the action of ammonium sulfate to be identical to that of the pitcher plant distillate and that it was the ammonium (NH_4) ion which had the selective obliterating effect upon the C fiber potentials.

METHOD

In this investigation 100 abdominal surgery cases were studied. Dolamin was used in fifty cases, the other fifty being used as controls.

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No attempt was made to select patients for either group. The operations and incisions used were nearly the same in each group. The purpose of the investigation was to study the effect of dolamin in the control of wound pain. Accordingly, the narcotic requirements from the day of surgery through the fifth postoperative day, or until dismissal if earlier than the fifth day, were recorded. (Table I.)

TABLE I
NUMBER OF NARCOTIC HYPODERMIC INJECTIONS

	Day of Surgery	Postoperative Days					Total
		1st	2nd	3rd	4th	5th	
Control....	1.90	2.32	1.26	0.60	0.32	0.20	6.60
Dolamin...	1.82	2.24	1.24	0.62	0.22	0.12	6.26

The floor nurses and house staff, except the surgical residents on occasions, were not aware of which patients received dolamin. As is no doubt true in most hospitals, many postoperative narcotic hypodermics were given for "rest." The intensity of wound pain was evaluated by the degree of tenderness or pain to palpation in the region of the incision and the freedom with which the patient moved and coughed. This was determined daily by one of us as a routine in rounds and recorded either 3, 2, or 1 plus, slight or none. (Table II.)

TABLE II
INTENSITY OF WOUND PAIN

	Day of Surgery	Postoperative Days					Total	Through 2nd P.O. da.
		1st	2nd	3rd	4th	5th		
Control.....	2.37	1.82	1.32	0.83	0.73	0.68	7.75	5.51
Dolamin....	1.55	1.22	0.91	0.76	0.64	0.52	5.60	3.68
Differential..	0.82	0.60	0.41	0.07	0.09	0.16	2.15	1.83

Twenty cubic centimeters of the anesthetic agent were infiltrated into the subcutaneous tissue and beneath the anterior fascia in each wound regardless of the location or length of the incision. This was done immediately following closure of the anterior fascial layer. Anesthesia and analgesia were directed at the thoracicoabdominal intercostal nerves beneath the anterior fascia and the anterior cutaneous branches of the thoracic nerves subcutaneously.

RESULTS

On the basis of narcotic requirements the dolamin patient received only slightly less postoperative hypodermic injections than did the control patient. The intensity of wound pain was definitely less in the dolamin patient through the second postoperative day than in the control patient. The difference from the third through the fifth postoperative days was comparatively slight.

COMMENTS

When dolamin is used to infiltrate surgical wounds at the time of closure, a minimal but definite decrease in the intensity of postoperative wound pain ensues, persisting through the second postoperative day in the majority of patients. There was no effect of the solution upon wound healing. No wound infections were attributable to the use of this drug. The effect was entirely sensory, no motor disturbances being noted.

Not included in this series were five bilateral inguinal herniorrhaphy cases in which dolamin was infiltrated on one side only. The intensity of pain in the dolamin wound was less than that in the control wound in four of the five cases and was readily differentiated not only by the writers but also by the patient and the house and nursing staffs. The fifth patient had slightly more pain in the dolamin wound throughout his hospital stay. All of these patients noted practically no difference in the intensity of pain in their wounds following the second postoperative day. Many of the patients in the main series were somewhat more conscious of their wounds following the second postoperative day. This is additional evidence in support of the conclusions reached from the statistics seen in Table II, namely, that the effect of dolamin is minimal after forty-eight hours.

SUMMARY

Dolamin,* a local analgesic, was used in a series of patients and found to give slight but

* Ammonium sulfate 0.75 per cent; benzyl alcohol 0.75 per cent; sodium chloride 0.48 per cent; ampul water q. s. 10.00 cc. Supplied by Harvey Laboratories, Philadelphia, Pa.

definite analgesia for about two days in post-operative wounds.

Control of wound pain in the immediate convalescence after surgical operations would be of great relief to the patient as well as an aid in early ambulation.

It is believed that the principle is good, but a more effective analgesic or anesthetic drug is desirable.

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USE OF ABSORBABLE GELATIN SPONGE AND PRIMARY SUTURE IN TRAUMATIC RUPTURE OF THE LIVER*

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THIS is the age of trauma. It is also the age of effective anti-shock therapy, selected anesthesia and improved mechanical aids for control of bleeding. The necessity for correct evaluation of hepatic injury is emphasized by a collected summary[18] showing 100 per cent mortality in 124 cases of patients with rupture of the liver who were not operated upon, contrasted with 43.3 per cent in 143 patients who were operated upon, without reference to associated lesions.

The literature has been recently reviewed by Newell,[12] and by Papen and Mikal.[13]

While an individual with a minor liver laceration may recover spontaneously, the extent of the tear, the amount of bleeding and the presence of injury to another organ cannot be ascertained without surgical intervention. The blood lost is not necessarily proportional to the size of the liver wound, and hemorrhage usually continues for the following reasons: the thin-walled hepatic veins do not retract and have no valves, bile mixed with blood interferes with the normal clotting mechanism, and the pump action of the diaphragm constantly alters intraperitoneal pressure.

Conservative management of the patient with ruptured liver leads to that regrettable state of departed opportunity.[11]

Incidence and Location. Over 70 per cent of all non-penetrating intra-abdominal injuries involve the liver or spleen. These organs rupture with at least equal frequency, a fact not well appreciated. Liver injury may be of three different types: tear of liver substance and capsule, subcapsular hematoma, and central hematoma. The first is by far the most common. The right lobe is six times more frequently involved than the left. Lacerations of the dome are most common, then the anterior and inferior, posterior, and lateral surfaces in order of decreasing frequency.

In automobile and industrial accidents there is often severe trauma to other parts, particularly to spleen, brain, lungs or bones. Any of the last three may render the patient so moribund as to lead to overlooking of the abdominal condition.

Diagnosis. The history is usually that of a severe direct blow or a squeezing injury to the upper abdomen or lower portion of the right rib cage. The chief symptom is abdominal pain, most intense in the upper abdomen. Reference to the shoulder is inconstant. There may be vomiting. General physical signs are those of shock and hemorrhage, manifest by pallor, weakness, restlessness, lowered blood pressure, rapid pulse (bradycardia is not common), subnormal temperature and a cool, moist skin. Diaphragmatic irritation may be evidenced by rapid, shallow breathing, often with a catch during inspiration. Local signs are tenderness and rigidity, first present in the upper right quadrant, later becoming more generalized as peritoneal irritation increases. Shifting dullness may be demonstrable if the hemorrhage is considerable. Peristalsis quickly becomes diminished or absent. Distention is a late sign.

However, the abdomen may be soft and flat in the early hours following injury, the tenderness minimal and the patient's general condition may appear deceivingly good. The picture may be suggestive of nothing more serious than simple contusion of the anterior abdominal wall. Whether bleeding is intermittent or constant, compensating physiologic processes often prevent the appearance of gross shock for many hours. Such latent period of fluid balance is the time of departing surgical opportunity when operation is life-saving and when it can be carried out with the greatest margin of safety. This time may pass unrecognized, the surgeon undecided as to the exact nature and extent of the injury, until the

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resulting downhill course becomes irreversible. A steadily rising pulse is the most reliable early sign of continuing concealed hemorrhage. Short interval re-examinations of the patient should be made until the question is settled.

In differential diagnosis the only consideration of importance is whether the abdomen must be opened. The question of which organ has been injured will depend upon the history of trauma, the general appearance of the patient and whatever localizing physical signs are present. More than one organ may be involved. In rupture of the liver concomitant injury of the right kidney, with blood in the urine, can prove a red herring and lead to fatal procrastination. While conservative treatment at least initially is indicated in rupture of the kidney, it is never indicated in rupture of any other intra-abdominal viscus.

Laboratory studies are not diagnostic. If the services of a blood bank are available, typing and cross-matching should be immediate. Red blood cell, hemoglobin and hematocrit determinations form a valuable basis for indication of the amount of whole blood needed for replacement therapy. Hemoconcentration, often present early in the course of a severe hemorrhage, should not be considered a contraindication to whole blood transfusion, nor should it be held as evidence against the presence of intra-abdominal bleeding.

Abdominal tap performed in one or more quadrants with a spinal needle and stylet[18] may be of aid if rupture of a solid viscus is questionable, but it is not necessary if significant signs for exploration are present.

Treatment. When rupture of the liver is suspected, operation should be done at once after determining the extent of other injuries unless the outcome is judged unquestionably fatal from these other injuries. Delaying operation in order to combat shock is not a good policy when progressing hemorrhage is the major contributory cause of the shock. Anesthesia and operation will not add a hazard comparable to continued blood loss, provided vigorous blood replacement therapy is instituted at once and provided oxygen is administered during operation. The decreased effective circulating blood volume resulting in lowered cardiac output and oxygen deprivation of body tissues should and must be corrected with whole blood. The longer this condition is allowed to persist the less the patient's chance for recovery.[15] Administration of electrolytes or plasma temporarily increases or sustains the blood pressure on a basis of increased circulating fluid volume alone, but it fails to remedy the most serious want, the depleted oxygen-carrying capacity. Therefore, in the presence of moderate or severe shock and hemorrhage as evidenced by falling blood pressure, rising pulse, oxygen want and pallor, or preferably before such signs have developed, whole blood should be given rapidly and in quantity. Simultaneous use of more than one vein or intra-arterial injection may be necessary. In preparing the bleeding patient for immediate surgery the term "slow drip transfusion" is a hang-over from the earlier days of questionable blood compatibility.

Animal experiments have led to warning of the possibility of sodium citrate poisoning when quantities of blood are administered rapidly.[4,7] Others believe such deaths are more likely on a basis of overloading of the blood stream, with resultant pulmonary edema.[16] Recent work by Eaton indicates that the hemorrhage itself is the cause of pulmonary edema.[5] If unusually large amounts of blood are required, calcium gluconate given simultaneously should afford adequate protection against the remote possibility of citrate toxicity.[7,16] During the Luzon campaign in World War II many patients with severe hemorrhage and shock were given as much as 5,000 cc. of citrated whole blood within a period of ninety minutes, without calcium gluconate, and with nothing but beneficial effect.[3]

Overtransfusion of the vigorously bleeding patient is not to be feared.

Operative Technic. The epigastric transverse incision readily extensible to right or left is most useful. Intraperitoneal blood and clots should be removed by suction together with any detached liver fragment.[2] Débridement of a ragged and badly contused liver wound is essential. Autotransfusion of removed blood because of the presence of bile and toxic products from degeneration of injured liver fragments should not be performed. Older methods of packing and draining liver wounds[6,8–10,14] leading so often to secondary hemorrhages and infection have been outmoded by the development of absorbable hemostatics. Chief among these have been gelatin sponge (gelfoam),

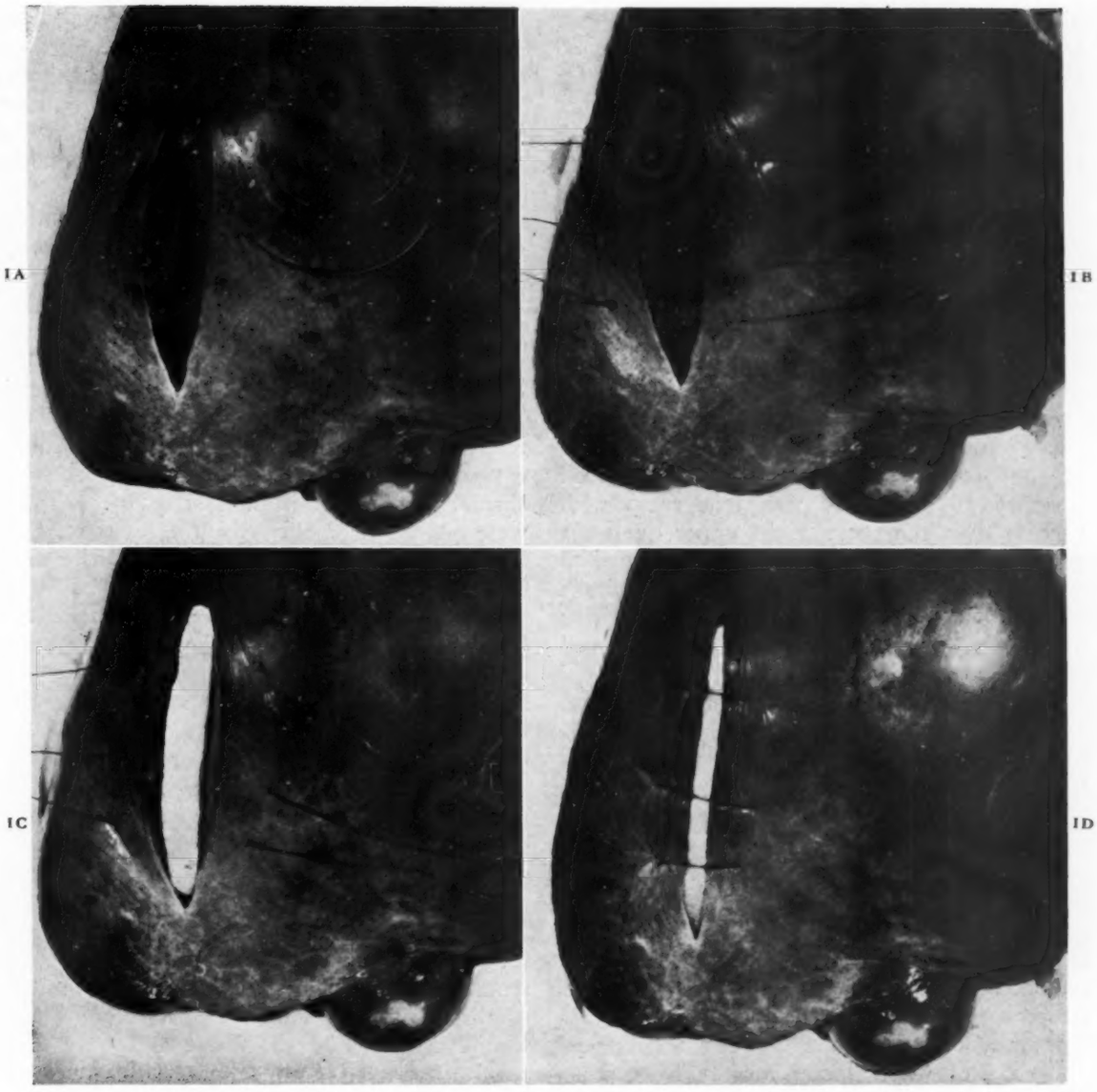

FIG. 1. A, simulated rupture of liver in autopsy specimen; large, round, curved needles are particularly useful in repair of liver; B, sutures of chromic catgut placed well away from wound edges and extending to complete depth of laceration in order to obliterate dead space; C, local hemostatic agent (gelfoam 200) cut to fit shape and depth of laceration; D, final result with sutures tied. Excellent hemostasis is obtained by this method, and drainage of the abdominal cavity is not necessary.

oxidized cellulose (oxycel) and fibrin foam. Any accessible liver laceration regardless of size and whether or not it is bleeding at the time of operation should be repaired by suture, augmented by the local use of a hemostatic agent. Interrupted sutures introduced well back from the wound edges should extend as deep into the liver substance as the base of the laceration in order to obliterate dead space. In the author's experience gelfoam 200, moistened with thrombin and cut to approximate the length and depth of the laceration, has proved extremely satisfactory. This material is fitted into the liver wound, and the previously placed sutures are tied, drawing the lacerated edges into approximation with it. (Fig. 1A to D.) If the tear exists over the dome of the liver and cannot be adequately exposed, the gelfoam may be manually placed within and over the liver wound and suturing omitted

since in this location there is little likelihood of the substance becoming dislodged. If good hemostasis is secured, there is no reason for drainage of the peritoneal cavity. Other organs should be examined for injury prior to closure.

CASE REPORTS

CASE I. M. M., a twenty-eight year old white female, was a passenger on the front seat of an automobile when it struck a bridge abutment. She was asleep at the time of the accident and was thrown violently against dashboard and windshield. When seen in the hospital accident ward forty-five minutes later she was pale, semi-comatose and in obvious severe shock. Pulse was 60, blood pressure 70/50. There was tenderness with rigidity over the entire right upper quadrant and flank. Peristaltic sounds were reduced to an occasional tinkle. There were crepitant fractures of the seventh, ninth and tenth ribs on the right, a laceration of the forehead and minor fractures of both lower extremities.

A diagnosis of ruptured liver was made, and the patient was operated upon immediately following a 500 cc. whole blood transfusion. Four hundred cubic centimeters of blood were removed from the peritoneal cavity, and a 10 cm. bleeding laceration on the ventral surface of the right lobe of the liver was repaired with chromic catgut sutures over gelfoam 200 and thrombin. A retroperitoneal hematoma originating from the right kidney region was not opened. The abdomen was closed without drainage.

During operation the patient was given 2,000 cc. of whole blood rapidly by double flow into arm and leg veins. This was supplemented with 1,500 cc. whole blood, 500 cc. plasma and 1,000 cc. glucose in saline during the first twenty-four hours. At the end of this time the blood picture showed red blood count 3,800,000, hemoglobin 75 per cent and hematocrit 45 per cent. The urine was grossly bloody for four days. The patient made an uneventful recovery except for a peripheral pulmonary infarction on the nineteenth day which responded to conservative measures.

CASE II. W. B., a twelve year old colored male, ran into a parked truck while riding a sled and struck his right lower chest and abdomen against a tire. There was immediate severe pain in the right upper abdomen, with inability to straighten the body or walk. He vomited twice. Physical examination showed a patient in obvious pain lying with the knees drawn up, fully conscious and cooperative. There was marked tenderness and rigidity of the right upper abdomen, with quiet peristalsis. The pulse was 110, blood pressure 120/40.

Operation was performed within three hours of the time of injury. Five hundred cubic centimeters of whole blood were administered. The peritoneal cavity contained 800 cc. of free blood and clots. The lateral surface of the right lobe of the liver presented an irregular, ragged tear approximately 17 cm. in length. This was débrided of partially detached fragments and closed with three deep, chromic catgut sutures tied over gelfoam 200 and thrombin. Two additional strips of gelfoam were placed over the area for security. One Dakin's tube drain was placed in the subhepatic space.

Forty-eight hours after operation the red blood count was 4,500,000, hemoglobin 61 per cent, hematocrit 41 per cent. Penicillin and streptomycin were given for seven days. The Dakin's tube drained nothing and was removed on the ninth day. A marked atelectasis of the right upper lobe complicated recovery. The patient was discharged sixteen days following injury.

COMMENTS

Use of the new hemostatic agents in general surgery has become widespread, but specific reports of use in human liver injury is limited to three cases by Papen and Mikal.[13] These were lacerations of the dome and were successfully treated by packing with strips of hemostatic agent, suturing being limited to the capsule, or anchoring of the capsule to the abdominal wall and diaphragm. Where the laceration is surgically accessible, the technic described herein carries greater certainty of hemostasis.

A recent report of three cases of retained oxycel sponge syndrome following cholecystectomy[17] indicates that this substance needs more thorough evaluation and should be used with caution within closed cavities. Gelfoam does not seem to exhibit undesirable physical properties. In Case II another condition made it necessary to reopen the abdomen twenty-seven days following the original liver repair. The previously injured area was

directly visualized and palpated. It was smooth, soft and except for a very faint grayness resembled normal liver. There was no evidence of the catgut sutures or the gelfoam.

Since 1931 in this hospital there have been eleven cases of patients with traumatic rupture of liver due to non-penetrating injury verified by operation or autopsy. Three have occurred within the past twelve months. Five of the patients were operated upon, with no mortality. (Table 1.) Six were given conservative treatment and all died. Of these six, four had extensive injuries to other parts and in two the liver alone was injured.

TABLE 1
PATIENTS OPERATED UPON FOR RUPTURE OF THE LIVER

Case No.	History of Injury	Location and Extent	Injuries to Other Parts	Treatment	Postoperative Complications	Mortality
1	Automobile accident, dashboard	Right lobe ventral 10 cm.	Kidney, ribs, lower extremities	Gelfoam and suture	Peripheral pulmonary embolus, right	0
2	Sled-riding accident, ran into truck	Right lobe lateral 17 cm.	None	Gelfoam and suture	Atelectasis, right upper lobe	0
3	Fell 15 feet	Right lobe dome 14 cm.	None	Packing with gelfoam	Pleural effusion, right	0
4	Struck by automobile while riding bicycle	Left lobe multiple lacerations	None	Sutured	None	0
5	Automobile accident, steering wheel	Subcapsular hematoma	None	Abdomen opened and closed	None	0

CONCLUSION

Traumatic rupture of the liver is an extremely serious and increasingly frequent injury almost invariably fatal without prompt surgical intervention. The patient's general condition temporarily may not reflect the severity of the internal bleeding and this is the time of departing surgical opportunity.

Whole blood should be transfused immediately, rapidly and in quantity. Abdominal exploration should not be delayed.

Liver lacerations should be repaired by primary suture, combined with local use of a hemostatic agent. Absorbable gelatin sponge (gelfoam) has proved an excellent material for this purpose.

March, 1951

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Patients with benign lesions of the colon (such as Hirschsprung's disease, multiple polypoid adenomas of the colon, diffuse ulcerative colitis, etc.) which require total colectomy for their radical cure can often be successfully operated upon by total excision of the colon, even in one stage, and yet their anal sphincteric mechanism can be preserved. In such cases a sort of Babcock pull-through procedure is adopted and the terminal ileum is pulled out through the anal opening and attached there after the anal mucosa and submucosa has been previously removed by the perineal route. In experienced hands the operation is quite successful and in a high percentage of cases complete preservation and function of the sphincter muscles is maintained. Unfortunately, in a few cases voluntary control is not immediately attained and, even if present at first, it may be lost later. (*Richard A. Leonardo, M.D.*)

FRACTURE OF METACARPAL BONES AND PROXIMAL MANUAL PHALANGES

TREATMENT WITH EMPHASIS ON THE PREVENTION OF ROTATIONAL DEFORMITIES

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INSUFFICIENT emphasis has been given to the prevention of fixed torsion deformities or overlapping of fractured digits in the course of treatment of fractures of metacarpals or of proximal manual phalanges. A study of normal fingers as well as of healed fractured ones has revealed that minimal overlapping of the fingers is easily detected when they are held in a flexed attitude. When these fingers are examined in the extended position, only those with marked torsion deformities are readily recognized as abnormal.

Passive rotary motion is present in the metacarpophalangeal joint of each finger in amounts of 15 to 35 degrees. The little finger presents the greatest range of such radial movement and the index finger the greatest range of such ulnar movement. (Fig. 1.)

If a fracture of a finger is treated using total encasement with adhesive plaster, plaster of paris bandage or traction, one may have difficulty in certain instances in detecting the presence of torsion of the involved fingers.[1] In order to prevent such torsion or overlapping of the flexed fractured digits, it is suggested that the mode of treatment should provide for (1) temporary lateral approximation of all the fingers in a flexed attitude and (2) easy access for inspection of the relative position of the fingernails in the immobilization apparatus.

1A 1B

FIG. 1. A, note the normal range of passive radial rotation of the flexed little finger. B, note the range of passive ulnar rotation of the flexed index finger.

A study of one group of cases with simple fractures of the metacarpals and another group with simple fractures of the proximal manual phalanges is presented in which torsion deformities of the fractured fingers were prevented.

Simple Fracture of a Single Metacarpal Bone (Exclusive of Thumb), Twenty-nine Cases. Eleven of the twenty-nine patients presented fractures in the region of the proximal third of a single metacarpal bone and the eighteen others showed fractures of the distal two-thirds of a single metacarpal bone.

2A 2B

FIG. 2. A, note the fixation of the distal fragment of the fractured metacarpal bone by rigid Kirschner wire. B, note healing at fracture site eight weeks later. Free movement is present in the joints of the little finger.

The fractures of the metacarpal bones were treated using fixation with rigid Kirschner wires.[2] After the fragments were realigned into normal relationships under brachial plexus block anesthesia or intravenous pentothal® solution, the fingers were placed in a flexed attitude. One to three wires were inserted in a horizontal plane anchoring the distal portion of the fractured metacarpal bone to one or two contiguous normal metacarpal bones. This was done while the fingers were held in a flexed attitude. (Fig. 2.) Small incisions were made in the skin for the easy introduction of the wires. The position of the wires in the metacarpal bones was checked by radiographic examinations made in the operating room. When this procedure was completed, the Kirschner wires were cut approximately ¼-inch beyond the skin surface. These free ends of the wire were buried in a light, short plaster of paris bandage. The latter encased the hand to the level of the necks of the metacarpal bones. There was no mechanical interference with active or passive movements at the metacarpophalangeal or interphalangeal articulations. The fingers could be placed in lateral apposition and were examined frequently in the flexed attitude in order to check for the presence or absence of a rotation deformity.

In two instances in which reduction of the fractured segments in the head or neck region of the metacarpal bone could not be accomplished by "closed manipulation," open reduction was performed. Through an incision made on the dorsal aspect of the metacarpal region near the web space the fractured bone was exposed and realigned. In these two cases fixation of the fragments was done by the introduction of a single heavy Kirschner wire. This was inserted in a vertical plane through the peripheral portion of the articular surface of the head and extended into the shaft of the ipsilateral or contiguous metacarpal bone. The shaft of the fractured bone was held in place temporarily with a second Kirschner wire. This wire was inserted in a horizontal fashion and was removed prior to the application of a short plaster of paris bandage about the hand. This bandage anchored the Kirschner wire which was inserted vertically into the articular surface and shaft of the bone. (Fig. 3.) The bandage did not interfere with the movements at the metacarpophalangeal joints of the non-fractured fingers.[3]

Generally the wires and the plaster of paris bandage were left *in situ* from four to six weeks, during which time callus usually made its appearance at the fracture region. Active movements of the fingers were encouraged by a program of occupational therapy and exercises which was started from twenty-four to forty-eight hours after reduction and fixation of the

FIG. 3. A, note fracture through neck of metacarpal bone of little finger; closed manipulation was not successful. B, treatment by open reduction and fixation with Kirschner wires; the (horizontal) wire in the shaft of the metacarpal bone was removed soon after the introduction of the vertical wire. C and D, note healing at the fracture site and realignment of the articular surface to the shaft. (Radiographs made eight weeks after the open correction.)

segments of the fractured bone. Follow-up examination made from three to five months after the initial treatment revealed healing at the fracture site and good alignment of the fragments. Excellent range of motion was noted at the metacarpophalangeal joints. There was absence of torsion or overlapping of the digits. (Fig. 4.)

Simple Fracture of the Proximal Phalanges of the Fingers (Thirteen Cases). Thirteen patients each with fractures of the proximal phalanges of one or more fingers were treated using the method of partial encasement of all the fingers in a plaster of paris mitten. By this means all the fingers were flexed and were in lateral apposition. In each of nine of these thirteen patients there was a fracture of the proximal phalanx of a single finger.[4] In the tenth case fractures of the proximal phalanges of two contiguous fingers were present while in each of two others the proximal phalanges of four fingers of one hand were similarly involved. The thirteenth patient presented fractures of the proximal phalanges of the four fingers of one hand and those of three fingers of the opposite hand.*

After correcting the position of the fragments of the fractured phalanges by manipulation and traction, a well padded gauze bandage was placed in the palm in the area bounded dorsally by the heads of the metacarpal bones,

* Most of the injuries in this group were caused by the impact of hatch doors of armored tanks against the hands.

4A 4B 4C

FIG. 4. A and B, note comminuted fracture of metacarpal bones of middle and ring fingers (two views); the wire fixation permitted early free movement of fingers (wires were removed during the sixth week). C, radiographs made five months after insertion of wires show complete healing at the fracture sites.

5A 5B

FIG. 5. A, note plaster of paris mitten about right hand for treatment of fracture of proximal phalanx of middle finger. B, note that the index, ring and little fingers can be mobilized without interfering with the position of the fractured middle finger.

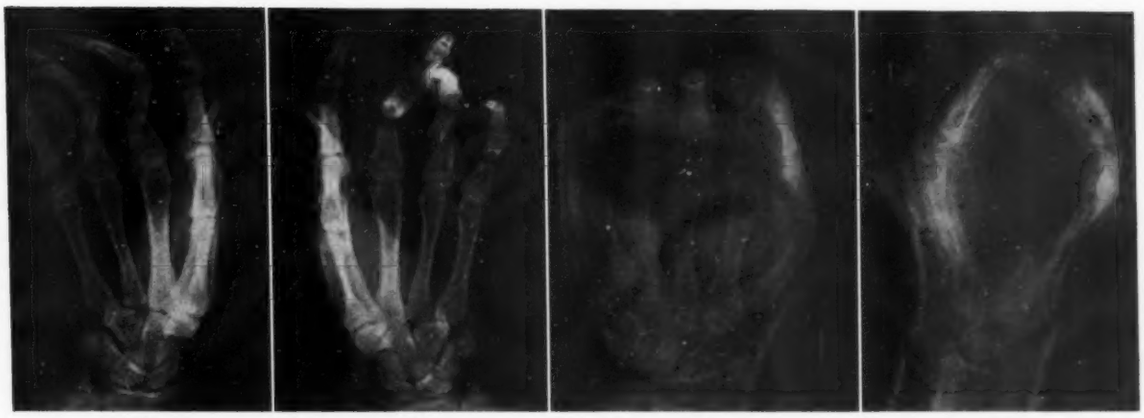
superiorly by the proximal phalanges and anteriorly by the distal phalanges. The gauze bandage was sufficient in size to hold the middle phalanges at an angle of 110 to 120 degrees to the proximal phalanges. The hand and the four flexed fingers which held the gauze bandage were encased with a plaster of paris bandage to form a mitten. By this means the fingers were held in traction, in lateral apposition and in flexion. The plaster covering the dorsal aspects of the proximal and middle phalangeal regions and the proximal portion of the nail areas was removed as soon as the bandage became dry. The tips of the digits were held in place by the plaster of paris mitten. If radiographic examination revealed that the segments of the fractured phalanx were not accurately aligned, pieces of felt were inserted in the area under the proximal phalanx in question and over the gauze bandage. The added felt pad increased the dorsal bow or distracted the fragments of the bone. The fingernails were inspected to determine their relative positions and were checked for signs of vascular disturbances.*

For fractures of the proximal phalanx of one finger all four fingers were encompassed in the plaster of paris mitten. (Fig. 5.) On the seventh to the tenth day of immobilization the three normal digits were passively released from the plaster of paris mitten several fifteen- to twenty-minute periods each day to permit them to undergo active and passive exercises.

The fingers were placed into the mitten when they were not exercised. The fractured digit was not disturbed from the plaster of paris mitten. After the twenty-first day of immobilization, however, the fractured finger was freed from the mitten for several fifteen-minute periods of exercise. The mitten was discarded during the sixth week of treatment.

Fractures of proximal phalanges of two or more fingers of one hand were treated using encasement of four fingers in a plaster of paris mitten as described previously. The normal

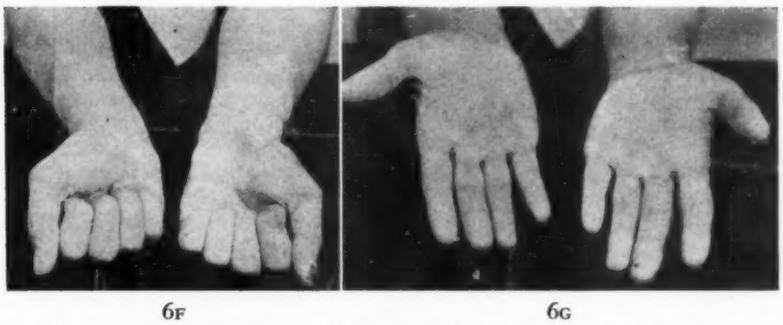
* Traction may be added temporarily to any one of the fingers in the flexed position in order to overcome any persistent recurrent overriding of the fragments.



6A 6B 6C 6D

FIG. 6. A and B, this soldier suffered from fractures of the proximal phalanges of the four fingers of the right hand (B) and of the proximal phalanges of three fingers of the left hand (A). C and D, this patient was treated with manipulation and immobilization, and plaster of paris mittens on the right and left hands; radiographs (C and D) show the left hand encompassed by the mitten.

FIG. 6E. Radiographs made four months after the fracture show complete healing of the seven fractured proximal phalanges.



6F 6G

FIG. 6F and G. Photographs made four months after fracture show the range of flexion and extension of the fractured seven fingers. There is absence of torsion or overlapping of the digits.

fingers were released daily from the mitten after the seventh to tenth postreduction day for several fifteen-minute periods of exercises and occupational therapy. The fractured digits were released daily for a similar period of time for exercises and occupational therapy approximately three weeks after the application of the plaster of paris bandage. The latter was discarded during the sixth or seventh week of treatment and more vigorous exercises were initiated. (Fig. 6.)

Follow-up examination of these thirteen patients made from three to six months after the occurrence of the fractures revealed a free range of active and passive flexion and extension at the metacarpophalangeal and interphalangeal joints of the fingers. There was no evidence of torsion or overlapping of the digits.

SUMMARY AND CONCLUSION

During the course of treatment of simple fractures of manual phalanges or of metacarpals consideration must be given to the passive rotary movements at the metacarpophalangeal joints as well as at the site of fracture. Since abnormal rotation or overlapping of the digits can best be recognized when the fingers are in a flexed attitude, the mode of treatment should permit all the fingers to be inspected in the suggested position. Fractures of one or more metacarpal bones were treated using fixation with rigid Kirschner wires and plaster of paris bandages. One, two or three Kirschner wires were inserted through the distal fragments into the contiguous normal metacarpal bones. The fingers were held in a flexed attitude during this procedure. In some cases of fractures of the neck or head region of the metacarpal bones a single wire was inserted in a vertical fashion through the articular surface and shaft of the bone. This method of therapy resulted in excellent apposition of the bone fragments without any rotatory deformity of the fractured digits.

Fractures of the proximal phalanges of one or more fingers were treated with immobilization of the four flexed fingers in a plaster of paris mitten. The normal fingers were released from the mitten on the seventh to the tenth postreduction day for exercises. The fractured fingers were similarly exercised on and after the twenty-first postreduction day. The plaster of paris mitten resulted in excellent apposition of the fractured segments, with preservation of motion at the joints without any evidence of torsion or overlapping of the fractured digits.

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FRACTURES OF THE CLAVICLE IN ADULTS

KIRSCHNER WIRE FIXATION (MURRAY METHOD)

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THE past few years have seen remarkable improvements in the treatment of fractures in general, but the care of fractures of the clavicle at the present time is about the same as it was a long time ago. In children the conventional bandaging and splinting for

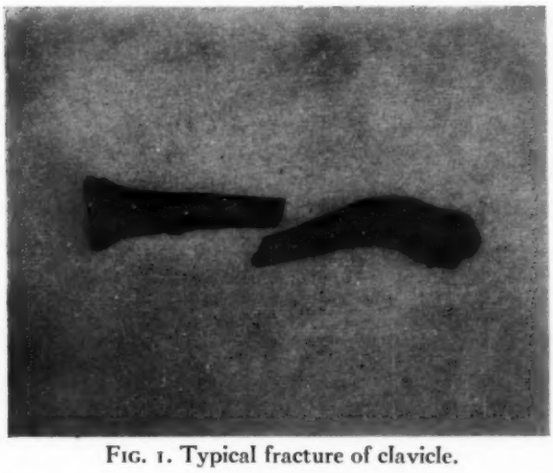


FIG. 1. Typical fracture of clavicle.

these injuries is generally satisfactory; and although angulation or overlapping of the fragments produces slight deformity in many instances, such deformity usually disappears during subsequent growth. Fractures of the clavicle in adults, on the other hand, cannot be managed so simply and present many difficulties. Under ordinary treatment these require immobilization for eight weeks or longer, during which period the patient is completely disabled. Furthermore, permanent deformity is common as it is not only impossible to reduce the fragments completely but also it is difficult to immobilize them satisfactorily by any form of bandaging or splints. Even after careful and prolonged support such fractures occasionally fail to unite. (Fig. 1.)

A satisfactory method of internal fixation for fractures of the clavicle in adults has been described by Gordon Murray,[1] and the principle of his technic is sound. A Kirschner wire is drilled lengthwise through the fragments to hold them securely. With this fixation no bandaging or splinting is necessary and thus disability for many weeks is avoided as the arm can be used freely. In addition, union is facilitated, and the deformity which is common after other forms of treatment is prevented.

Although the principle of such treatment is logical, we have not been able to reduce these fractures without an open operation, and we have failed in attempting to insert the Kirschner wire "blindly" as described in the first part of Murray's paper. The clavicle is a dense bone, having no medullary canal, and the end of the Kirschner wire slips off the fragments easily. In the latter part of his paper Murray stated that in several instances it was necessary to make a small incision over the fracture site to control the fragments, and in these instances he also modified the manner of inserting the Kirschner wire. We have used that modification routinely in treating fractures of the clavicle in adults, and the results have been gratifying.

TECHNIC

The fracture is exposed through a 2-inch incision. A double-pointed, thick Kirschner wire is used. Starting at the site of fracture it is drilled outward through the distal fragment, its free end emerging through the skin over the shoulder. (Fig. 2.) The drill then is removed from the inner end of the wire and is transferred to the outer end which projects through the outer side of the shoulder. (Fig. 3.) The fragments now must be reduced and held together with a bone clamp, while the wire is drilled backward through the distal fragment, across the line of fracture, and then is drilled deeply into the proximal fragment. Next, that portion of the wire which projects through the skin over the shoulder is cut off as short as possible and the overlying skin drawn outward to cover it. Finally, the subcutaneous tissues and skin are closed with a few sutures. It is not necessary to apply either a splint or

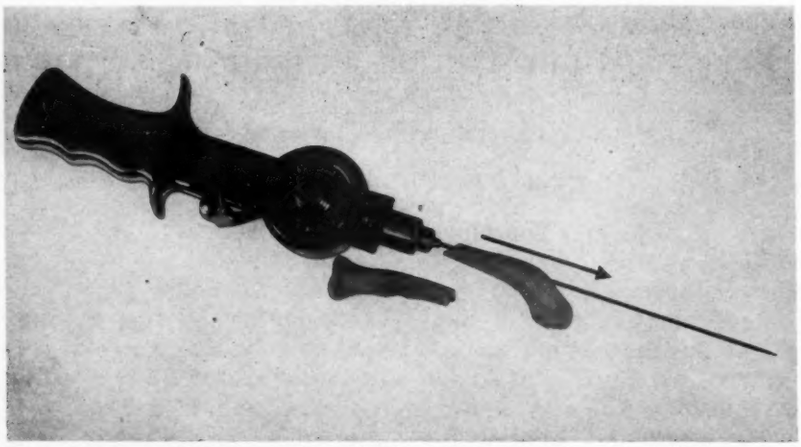
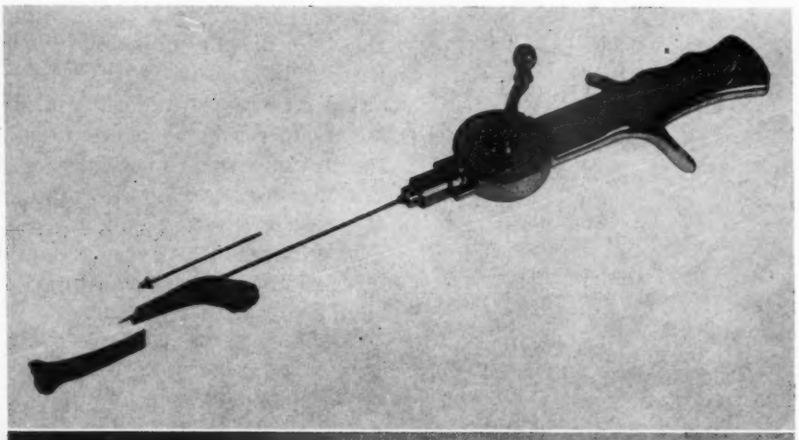


FIG. 2. A heavy Kirschner wire which is pointed on each end is drilled outward through the distal fragment; the end pierces the skin on the outer side of the shoulder.



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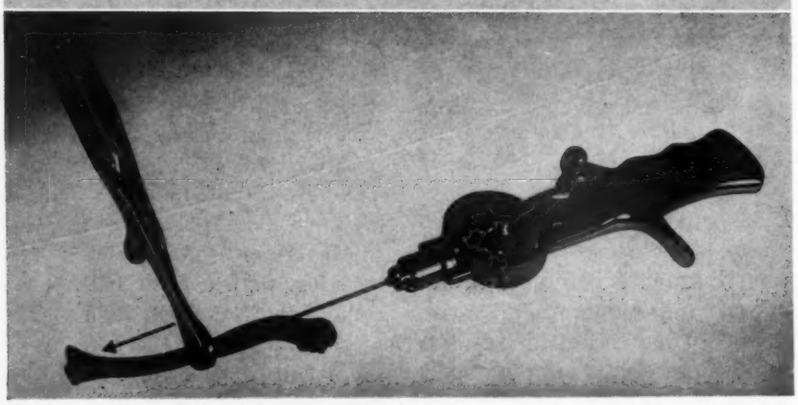

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FIG. 3. The drill has been removed from the inner end of the wire and is fastened to the outer end of the wire.

FIG. 4. The fragments have been alined and are held with a clamp while the wire is drilled across the fracture line and well into the proximal fragment. Finally, that portion of wire which projects through the skin over the outer aspect of the shoulder must be cut off.

FIG. 5. Fracture of clavicle before and after Kirschner wire fixation.

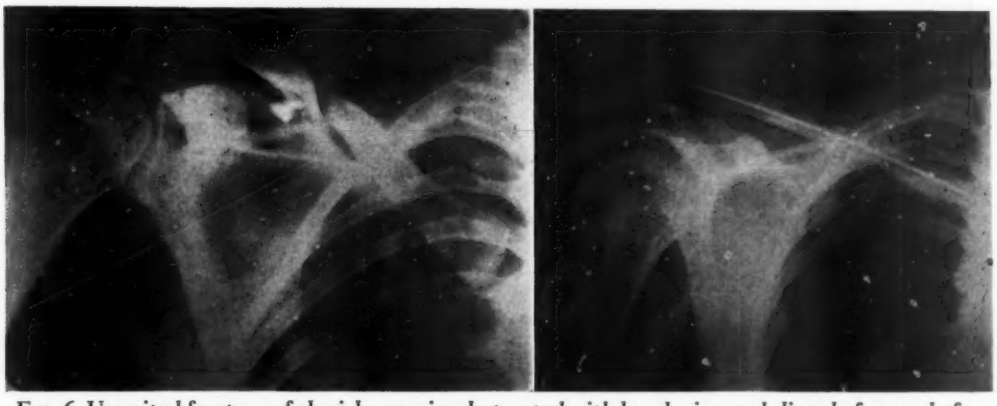

FIG. 6. Ununited fracture of clavicle, previously treated with bandaging and sling, before and after grafting combined with Kirschner wire fixation.

even a sling, as the Kirschner wire passes through almost the entire length of the bone, and thus provides secure fixation. (Fig. 4.)

RESULTS

This method has been found very satisfactory. The patient is encouraged to exercise on the first postoperative day and experiences little pain on movements of the shoulder. In some instances it has been possible to resume light work as soon as two weeks after the operation, without further disability.

The follow-up care is simple. The Kirschner wire is removed after six or eight weeks, the skin is nicked and as its end protrudes through the opening is withdrawn with a sterilized pair of pliers. (Fig. 5.)

In the writer's series of twenty-eight cases there was little inconvenience during treatment, and all except one of the fractures united satisfactorily. (Fig. 6.) In this fracture the break was close to the sternal end of the bone, and the wire should have been inserted in the opposite direction. There was one infection which was not serious and did not interfere with union. As the heavy Kirschner wire was drilled into both fragments securely, there was no instance of loosening or migration. This form of treatment has prevented the deformity and disability which are common with the inefficient conservative treatment, and the patients have been remarkably comfortable. The results of this technic are so satisfactory that it is recommended as the method of choice for most fractures of the clavicle in adults; however, like other open reductions, this operation should not be attempted by surgeons who have not had considerable experience with fractures.

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INTRA-ARTERIAL AND ORAL PRISCOLINE®*

A CLINICAL REPORT

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OUR desire to improve function and effect healing in certain peripheral vascular diseases prompted us to study the effects and indications of priscoline® hydrochloride (2-benzyl-imidazoline-hydrochloride). Meier and Mueller[1] found that the action of priscoline® administered either parenterally or orally is one of generalized peripheral vasodilatation. The effect appears to be upon the termination of sympathetic motor nerves in smooth muscles. Meyer[2] did further work which clarified some aspects of the adrenolytic action of priscoline,® after which Chess and Yonkman[3] demonstrated that the drug is not completely sympatholytic or adrenolytic at the cervical sympathetic level. This finding helps elucidate certain inconsistencies observed in clinical experience.

Luft[4] in comparing the effects of several drugs upon the skin temperature of healthy individuals and two persons suffering from peripheral vascular disease found that priscoline® caused the greatest rise of temperature. Green and Ogle[5,6] carried out more extensive clinical studies comparing the effects of body warming and several vasodilator drugs (including spinal anesthesia) upon normal and diseased extremities, finding priscoline® to be a useful drug in the evaluation and therapy of peripheral vascular disease. Grimson et al.[7,8] at Duke University further extended our knowledge of the clinical effectiveness of priscoline.®

Our cases for the most part were unselected and were of the type found in peripheral vascular disease clinics. (Table 1.) Fourteen of these cases were from the Peripheral Vascular Service of Harlem Hospital and three from private practice. Nine patients showed gratifying results while eight showed only slight response. The cases consisted of six refractory leg ulcers, four diabetic ulcers with necrosis, three gangrene of the toes, one phlegmasia cerulea dolens, one scleroderma and two cases of vasospasm which did not disappear even after ligation for varicose ulcers. (Table 1.)

TABLE 1

Pathology	*No. of Cases*
Refractory ulcers of leg	6
Arteriosclerotic	2
Traumatic	2
Thrombophlebitic, chronic	2
Diabetic ulcers with necrosis	4
Gangrene of toe	3
Diabetic	2
Arteriosclerotic	1
Vasospasm in varicose ulcers (after vein ligation)	2
Phlegmasia cerulea dolens	1
Scleroderma	1
Total	17

Our experience with priscoline®† in these seventeen cases is of interest because (1) it gave additional data as to indications and contraindications and (2) it indicated that the drug in therapeutic doses was non-toxic.

METHOD OF STUDY

We reviewed skin temperatures and oscillometric readings, radiographs, serum proteins, blood chemistry, hematology and the general condition of the patient after thorough examination. Venography and arteriography were avoided because of our impression of their inherent dangers in these cases.

Our reason for the combined method of administration, namely, intra-arterial and oral, was the refractory character of the lesions which prompted us to concentrate the drug in the affected areas. Weissenbach and Fanlong[9] as well as Kappert[10,11] in Switzerland used the drug intra-arterially, but we did not know it at the time this study was started. Our investigation by this method is independent.

† Priscoline® for this study provided by Ciba Pharmaceutical Products, Inc., Summit, N. J.

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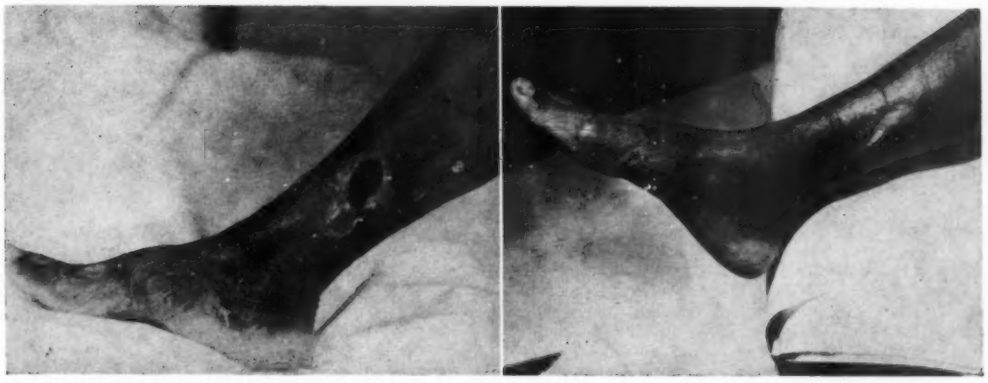

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FIG. 1. Patient A. P., No. 551, Table II. Shows arteriosclerotic ulcer of two years' duration prior to priscoline therapy.
FIG. 2. Scar of healed ulcer forty-two days after therapy was started.

An 18 or 20 gauge needle was inserted at right angles into the femoral artery just below Poupart's ligament. The bright color of the arterial blood as well as the arterial pressure forcing the piston of the syringe upward made one realize that the needle was in the artery rather than the vein. Within ten seconds after injection the patient invariably experienced an intense warmth and burning sensation in the foot which lasted for a few minutes. During this time there was a moderate increase in pulse rate without subjective symptoms. Skin temperature readings taken before and immediately after the injection showed an elevation in some cases as early as five minutes after the injection. The rise in temperature lasted as long as four hours after administration and varied from 1° to 6°F., depending upon the degree of the pathologic disorder. We found that in those cases manifesting arteriosclerotic disease the rise was not as sustained as in patients with other pathologic conditions. We have recorded a rise of 4.5°F. in fifteen minutes in cases of advanced arteriosclerosis when subcutaneous or intramuscular injection had failed to give response in the same patients. We employed the Leeds Northrup potentiometer for these readings at a room temperature of 75°F. Elevation in oscillometric reading above the ankle was not manifested as a rule until about half an hour after the injection, and it lasted for about two hours.

The dosage used in both intra-arterial and oral administration varied with the type of case, age of patient and character of the lesion. The average intra-arterial dose was 50 mg. given once daily for a maximum of twenty-one days. This was supported by oral administration of 200 mg. divided into four equal doses. Our clinical follow-up of these cases showed that there was no damage to the artery or the tissues around it. The work of Schneierson and Blum[12] has shown that no gross or microscopic abnormalities exist in the femoral arteries of dogs and man examined six, twenty-eight and forty-two days after femoral intra-arterial infusions.

Untoward reactions were negligible. In one case there was a slight drop in systolic and diastolic blood pressure ten minutes after the injection. This drop occurred after the second injection only. In this regard it is interesting to observe that Marzoni, Reardon, Hendrix and Grimson[13] found that priscoline® in therapeutic dosage does not significantly reduce blood pressure in the supine or erect position. We encountered no postural hypotension. In two cases a mild transitory rash was seen, but we were able to continue the drug by mouth despite this.

Table II cites the cases in which gratifying results were obtained. Figures 1 and 2 serve to illustrate a case of arteriosclerotic ulcer (A. P.) preceding and following priscoline® therapy. In Table III are listed the cases in which results were not striking and which went on to operation.

Because of special interest the case history of a patient with phlegmasia cerulea dolens is briefly described and is listed in Table III.

C. G., a fifty-six year old white female, complained of chills, fever, cough and chest pains for one day. She was admitted to the Medical Service on January 31, 1949, with massive swelling, redness and tenderness of the entire right lower extremity. The swelling, which was

TABLE II

CASES IN WHICH THERE WAS RESPONSE TO PRISCOLINE®

Case No.	Sex and Age	Diagnosis	Duration of Lesion (yr.)	Days under Treatment	Untoward Effects	Operative Procedure	Results
A. P. 551	F-73	Arteriosclerotic ulcer, right leg	2	43	None	None	Cured
B. L. 5729	M-52	Traumatic ulcer, right leg	1½	71	None	None	Cured
G. F.*	F-53	Vasospasm due to varicose ulcer, left leg	1	30	None	Ligation of veins prior to priscoline®	Cured
J. G. 3511	M-30	Thrombophlebitic ulcer, left leg	1	33	Papular vesicular rash	None	Cured
H. P. 4683	M-55	Large refractory ulcer due to chronic thrombosis of veins, left leg	18	8 mo.	None	None	Improved
H. M. 16976	M-64	Multiple arteriosclerotic ulcers, both legs	3	48	Dermatitis venanata	None	Improved
C. P. 14934	M-31	Traumatic ulcer, left leg	2	60 (Outpatient Dept.)	None	Ligation of veins prior to priscoline®	Cured
J. G. 9292	M-69	Traumatic ulcer, left leg	2	35	None	None	Cured
B. D.†	F-61	Scleroderma, quadrilateral	3	20	None	None	Improved

* Private patient.

† Private patient; lone patient of entire series given only oral priscoline.®

TABLE III

CASES IN WHICH THERE WAS NO RESPONSE TO PRISCOLINE®

Case No.	Sex and Age	Diagnosis	Duration of Lesion	Days under Treatment	Untoward Effects	Operative Procedure	Results
L. G. 3984	F-69	Arteriosclerotic gangrene, left foot	3 mo.	18	None	Mid-thigh amputation	Cured
E. G. 3409	M-59	Multiple arteriosclerotic ulcers with necrosis, right leg	13 mo.	26	None	Mid-thigh amputation	Cured
E. W. 19492	F-38	Diabetic ulcer with gangrene, left foot	13 mo.	40	None	Mid-thigh amputation	Cured
M. M. 16996	F-58	Diabetic ulcer with necrosis, right foot	6 mo.	35	None	Lumbar sympathectomy	Cured
C. G. 2238	F-56	Phlegmasia cerulea dolens, right lower extremity	2 da.	15	None	Lumbar sympathectomy	Cured
J. I. 8559	M-60	Diabetic ulcer with gangrene, left foot	9 mo.	24	None	Mid-thigh amputation	Cured
S. S.*	M-56	Diabetic gangrene with anaerobic streptococcus infection, left foot	1 mo.	19	None	Mid-leg amputation	Cured
C. L. 19232	M-57	Diabetic ulcer with gangrene, left leg	3 mo.	32	None	Sympathectomy followed with mid-thigh amputation	Cured

* Private patient.

unilateral, extended as far as the inguinal ligament and Homans' sign was positive. The dorsalis pedis was not palpable and the toes were cold and cyanotic. Dullness and moist rales were present over the upper right lobe the following day when the patients temperature reached 103.2°F. On the third day the radiographic examination showed consolidation of the upper right lobe, and pneumococcus, Type v, was recovered from blood culture. The cold hemagglutination titer was 1:8, but it was negative on two subsequent days although the temperature was still elevated. Blood chemistry and serum proteins were normal. Cephalin flocculation test was 2 plus and the urine was negative except for 2 plus albumin. Electrocardiographic examination was negative.

The fastigium and course of the disease led to the diagnosis of lobar pneumonia complicated by phlegmasia cerulea dolens manifested by severe thrombosis of the right femoral vein and marked arterial spasm. On the eighth day the tips of the toes evidenced a dry gangrene although the dorsalis pedis had by this time become faintly palpable. Debakey and Ochsner[14] in discussing the pathogenesis of phlegmasia cerulea dolens state, "Obstruction of the venous return in an extremity, provided that it is of sufficient extent, can cause a great reduction in the arterial blood flow. On this basis it seems reasonable to assume that in cases of severe venous thrombosis associated with gangrene, the primary factor responsible for the arterial manifestations is massive venous occlusion."

Due to duration of the phlebothrombosis thrombectomy was not considered. Intra-arterial priscoline® was administered daily for fifteen days with the hope that collateral circulation proximal to the line of demarcation would become sufficiently enhanced to effect a spontaneous amputation of the tips of the toes. The edema of the leg did not respond, but the line of demarcation of the gangrenous tips became more clear-cut. Lumbar sympathectomy was done on May 12th following a test lumbar paravertebral block. The edema then diminished progressively, and twenty days later spontaneous amputation of the tips of the toes resulted. The patient was discharged as cured on June 2, 1949.

Case A. P., illustrated in Figures 1 and 2, shows the healing of an arteriosclerotic ulcer of two years' duration in a period of six weeks, at the end of which the dorsalis pedis became palpable. Local therapy was limited to cleanliness and furacin ointment. Temperature and oscillometric readings remained improved up to one year after treatment. This patient serves to illustrate the fact that recanalization of an artery following relief of vasospasm may sometimes occur.

COMMENT

Priscoline® in our hands proved effective in the treatment of refractory leg ulcers provided therapy was started prior to the onset of gangrene or established soft tissue necrosis. Gratifying results were seen in the relief of vasospasm due to various causes such as trauma, the symptom complex of scleroderma and ulceration from arteriosclerosis, diabetes or thrombophlebitis. It also proved valuable in relieving the vasospasm which persisted after vein ligation for varicose ulcer.

In severe cases in which gangrene or established soft tissue necrosis had started we were unable to produce sufficient collateral circulation proximally to effect either a spontaneous amputation or a lower site for surgical amputation. This fact is not surprising in the light of the not infrequent failure of lumbar sympathectomy to produce the same end result. It is our impression, however, that intra-arterial priscoline® supported by oral therapy may replace lumbar sympathectomy in selected cases of vasospasm as well as ulceration prior to the stage of advanced necrosis.

We believe that non-hospitalized patients should be kept in the recumbent position for about an hour following intra-arterial injection of priscoline.®

In contrast to etamon (tetraethylammonium chloride or bromide), the action of priscoline® is more protracted and a marked drop in blood pressure is seldom encountered. We have not used dibenamine® (dibenzyl beta chloroethylamine hydrochloride) in our study of sympatholytic or adrenolytic drugs.

SUMMARY

The action of intra-arterial priscoline® supported by oral therapy has been studied intensively in seventeen cases of peripheral vascular disease. From the cases observed we may state that the drug is a valuable adjunct in two types of cases, namely, refractory leg ulcers prior to the onset of gangrene or established soft tissue necrosis and vasospasm whether due to trauma,

the symptom complex of scleroderma or ulceration due to arteriosclerosis, diabetes or chronic thrombophlebitis.

Acknowledgments: We wish to give thanks to Dr. Aaron Prigot for supplying the data on the case of scleroderma and to Dr. Robert S. Wilkinson for referring the case of diabetic gangrene with anaerobic streptococcus infection.

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Modern Operative Technics

No. 3

HIRSCHSPRUNG'S DISEASE*

NEW SURGICAL TREATMENT

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FROM the beginning of the nineteenth century descriptions of Hirschsprung's disease were recorded in both the German and English languages. Finney[1] in 1908 reviewed the medical literature and published a comprehensive report on the disorder. The accuracy and completeness of Hirschsprung's description makes his contribution a noteworthy historical reference.[2]

Following this a large number of publications have appeared proposing a variety of explanations of the pathology of this curious disease. Those who believed the pathology was centered in the dilated bowel excised or bypassed this portion of the colon only to find that recurrence took place. Even colectomy with ileosigmoidostomy failed to cure the patient in all instances, and dilatation of the terminal ileum followed. We have observed two patients with marked recurrence of the disease in the ileum following colectomy. One died as a result of the recurrence and the other was relieved of his symptoms by an ileostomy.

Another school of thought was that an elusive form of distal obstruction, mechanical in nature, was the basic lesion. Volvulus of an unusually long colon was often described and excision of the dilated colon performed to straighten out the bowel. Such procedures were often followed with recurrence.

Men who believed that an overbalance of sympathetic nerve supply to the distal colon inhibited normal colonic and sphincteric function resorted to various forms of lumbar and pelvic sympathectomy. The early physiologic studies of the intestinal tract by Bayliss and Starling[3] and Cannon,[4–7] and later work by Adamson and Aird,[8] Wade and Royle,[9] Learmonth,[10] and Scott and Morton[11] seemed to evolve a promising theory with clinical application. Nevertheless, follow-up of patients treated with sympathectomy has revealed disappointing results.

Four years ago one of the authors (O. S.) observed that three patients with Hirschsprung's disease were completely relieved of their symptoms by colostomy, following which the colon became normal in size.[12] It was postulated that there was a functional obstruction in the rectosigmoid. The nature of this obstruction has since been clarified by colonic motility studies described in an earlier report from this hospital.[13] These kymographic tracings from three balloons have clearly indicated that peristalsis progresses in orderly normal fashion through the patient's megacolon but does not enter the rectosigmoid. This aperistaltic segment has been found to be entirely devoid of a myenteric plexus in forty-five of our cases. In forty-four cases there was absence of Auerbach's plexus in the entire rectum, with a variable segment of bowel above. One case was unusual in that the distal rectum contained ganglia; above this was a short segment lacking myenteric plexus, with the bowel proximally once again normal. (Twelve of the earlier operative specimens were improperly sectioned and new studies have not been completed.) We believe that absence of the myenteric plexus in a part of the distal colon is the fundamental

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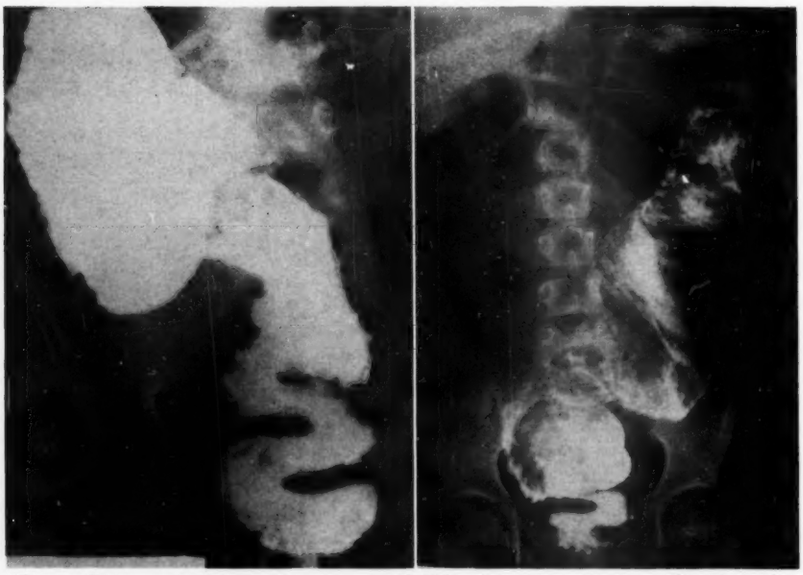


FIG. 1. Roentgenograms of patient with Hirschsprung's disease; distal to the enlarged sigmoid the rectosigmoid and rectum are narrow. This is the aganglionic segment which is devoid of peristalsis.

pathology in Hirschsprung's disease. This finding corroborates other reports.[14,15,29]

The work of Hill[16] and others indicates that anatomically the myenteric plexus is made up of ganglia of a parasympathetic nature. Magnus,[17] Cannon,[18] Alvarez[19–22] and many others have contributed to the concept that intestinal peristalsis is dependent on the presence of the myenteric plexus rather than on the bowel's extrinsic nerve supply. It is unfortunate that repeated efforts to destroy selectively this hardy plexus in a segment of bowel for long range experimental observation employing the methods of Cannon and Magnus, have proved futile in our hands[23] and in the past by others.[20,24]

That a megacolon can develop from various causes, such as a congenital rectal diaphragm, atresia, carcinoma, atropine intoxication or from spinal cord and lumbosacral nerve injuries, needs no elaboration. Any chronic status preventing normal evacuation, whether functional or mechanical, is capable of producing a dilated colon. Thus chronic constipation is the most common cause of megacolon. Each case of megacolon should be studied to determine its fundamental cause, and definitive treatment performed on the basis of these findings.

A patient with Hirschsprung's disease usually has a history of severe constipation dating from birth, and on examination the abdomen is found to be distended with palpable fecal impaction in the lower quadrants. The rectal ampulla is usually empty. These children are often poorly nourished and pale. An absolute diagnosis can be made only by careful barium enema study.

The pathognomonic rectosigmoid lesion of Hirschsprung's disease is difficult to demonstrate by routine barium enema. Neuhauser recommends that a small amount of barium be injected while the patient is fluoroscoped in an oblique position.[25] The narrow, irregular, distal lesion then becomes apparent as the dilated bowel above begins to fill. This narrow segment may be missed if a large amount of barium is rapidly injected into the overlying megacolon. (Fig. 1.) All patients in our series eventually revealed this type of lesion although seven examined in the neonatal period were initially "negative." Several months later re-examination demonstrated the defect in these patients, now defined by the marked proximal dilatation. All of these patients then presented a "funnel-shaped" deformity with the dilatation converging into a narrow, irregular segment. Another important finding is the inability of the colon to evacuate the instilled barium completely.

Fortunately these children are usually free of other congenital anomalies. The only mal-

formation of importance found was mongolism and congenital heart disease in one patient. Treatment here was limited to a palliative transverse colostomy.

Associated urinary tract dysfunction, although seldom noted by the patient or the parents, has in some instances been detected by cystometric studies. Ten of twenty-two preoperative cystometrograms were abnormal, revealing large atonic bladders unresponsive to filling until distended. Postoperatively these cystometrograms were essentially unchanged. In addition one patient was noted at operation to have a left megaloureter, another bilateral hydroureters, and a third by pyelography was found to have bilateral megaloureters. The combination of megacolon and megalobladder has been reported by several authors,[26–28] indicating that the relationship of bladder and colon dysfunction is more than coincidental.

It is probable that a common defect in the pelvic parasympathetic outgrowth from the primitive neural crest may give rise not only to an aganglionic segment of colon but also to areas in the bladder which lack a parasympathetic plexus. The pathology of the urinary tract in Hirschsprung's disease is at present being investigated.

The pathophysiology underlying this disorder indicates the definitive form of treatment to be a resection of the defective segment of bowel. Supportive treatment has repeatedly failed except as a temporary means of alleviation. Fifteen patients received adequate medication with mecholyl in the hope that this drug would increase the peristaltic power of the colon. Together with enemas and laxatives this medication was apparently able to overcome temporarily the obstruction of the defective segment. Normal evacuation was noted in eight patients during periods of a few months to over a year. Each child gradually became resistant to the drug and the regimen then failed. The use of mecholyl, enemas and cathartics intelligently employed can, however, be used to tide a patient over until definitive treatment is possible.

Relief may also be obtained from a colostomy above the aganglionic segment of bowel. This is additional proof that the basic lesion is not the dilated colon but the obstruction of the peristalsis-lacking distal bowel. In our series twenty-three colostomies and three ileostomies have been performed, all with relief of symptoms. In four cases colostomy closure was performed before removing the obstructing segment, with recurrence of all symptoms. After resection of the defective bowel all colostomies have been successfully closed.

Colostomy was avoided unless the patient was in desperate need of decompression and could not tolerate resection at that time. Also, a few cases with a heavily impacted sigmoid could not be adequately cleaned out from below, making primary resection hazardous. For these cases a simple transverse loop colostomy was found to be most suitable.

The operation of rectosigmoid resection, worked out in the research laboratory by Swenson[12] and reported in 1948, has proven to be highly satisfactory in the surgical treatment of sixty-nine cases of Hirschsprung's disease.

Of great importance is the preoperative preparation of the patients which should begin at home four weeks preceding operation. The patient should be placed on a low residue diet and given mineral oil and one to two enemas daily. Adequate doses of sulfasuxidine to loosen the fecal stream and reduce the bacterial count of the bowel contents should be started two weeks prior to operation.

At operation a cutdown is utilized for intravenous therapy. The patient is placed in a lithotomy position with draping so arranged that abdomen and perineum may be simultaneously approached. (Fig. 2A.) A suprapubic incision slightly to the left of the midline is utilized for the intra-abdominal phase of the resection. The approximate extent of the defective segment of bowel as determined by x-ray is identified, most often involving the lower sigmoid and rectum. In four patients the sigmoid and in one the entire distal colon from the left half of the transverse colon to the anus was implicated; in one patient there was normal bowel below the aganglionic segment; in every other patient the entire rectum was defective.

An area 12 cm. proximal to the point of narrowing is selected for the line of resection. It is crushed and stapled with a von Petz clamp. (Fig. 2B.) The same instrument is used as low as possible on the rectosigmoid. This segment is then removed with a phenol knife. A frozen section is made from the proximal end of this resected segment to determine the

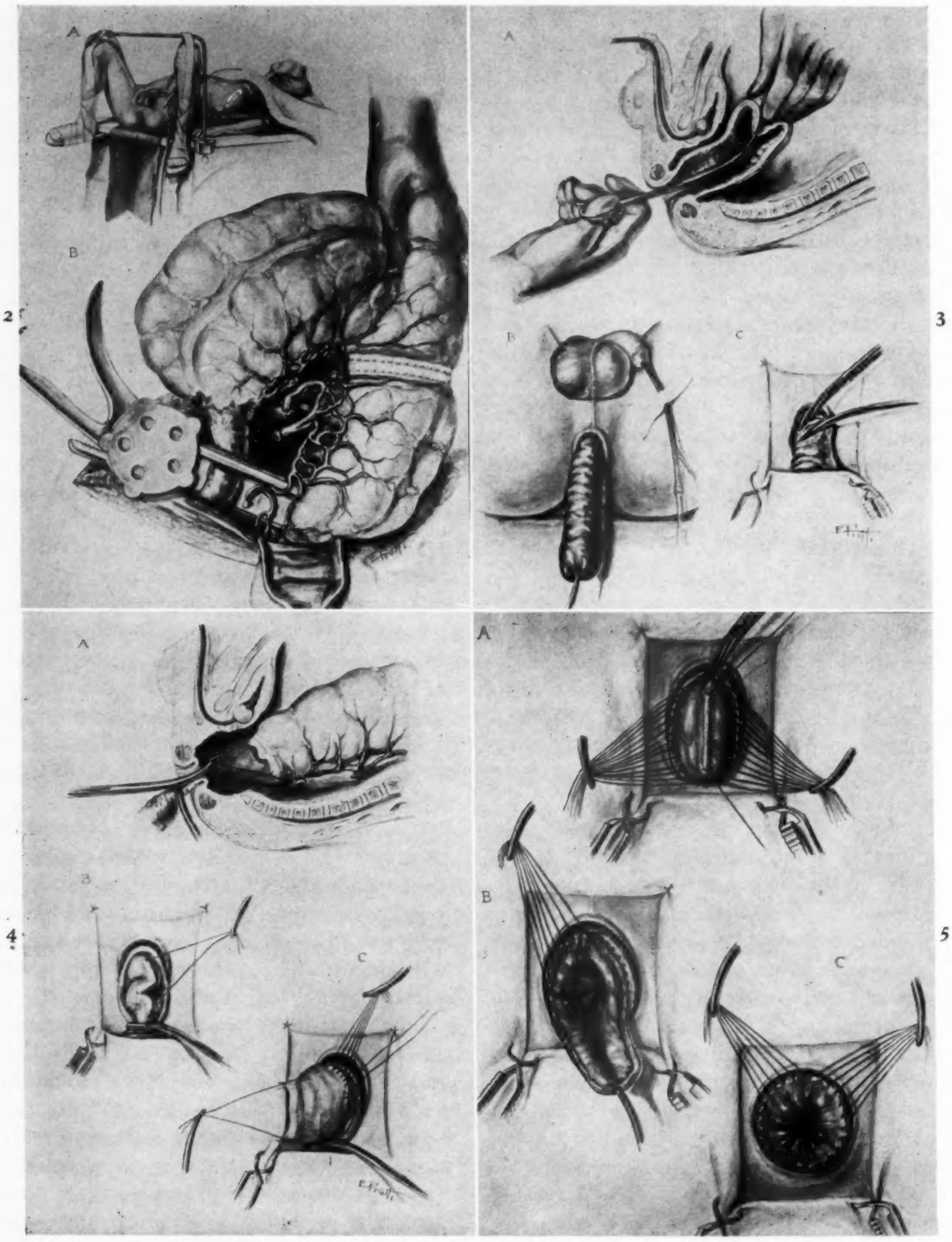


FIG. 2. A, patient is positioned on the operating table so that the abdomen and perineum can be simultaneously approached; B, von Petz clamp resection of a large portion of the proximal defective bowel which facilitates pulling the rectosigmoid down and provides material from which a frozen section can be taken.

FIG. 3. A, the stapled end of the rectosigmoid is grasped from within and everted down through the anus; B, the everted bowel mucosa presenting is cleansed and readied for draping; C, the bowel is partially divided 2.5 cm. from the sphincter.

FIG. 4. A and B, the normal proximal colon is pulled into view by means of sutures attached to the bowel; C, the anastomosis is begun by placing a row of interrupted silk sutures through the muscular coats of the two segments. After this row is finished, the cut across the distal bowel is completed.

FIG. 5. A, B and C, the proximal closed loop of bowel is opened and the mucosal layer of the anastomosis is performed using interrupted catgut sutures.

presence or absence of ganglion cells. If none are found, additional bowel is removed until normal ganglion cells are present. The remaining colon must be of sufficient length for pulling through the anus and anastomosing below without tension. There is always a sufficient length of bowel; the limiting factor is the blood vessels. Division of the sigmoidal (and in eight cases the left colic) vessels near their origin eliminates this limiting factor and provides a vascular arcade which supplies adequate circulation.

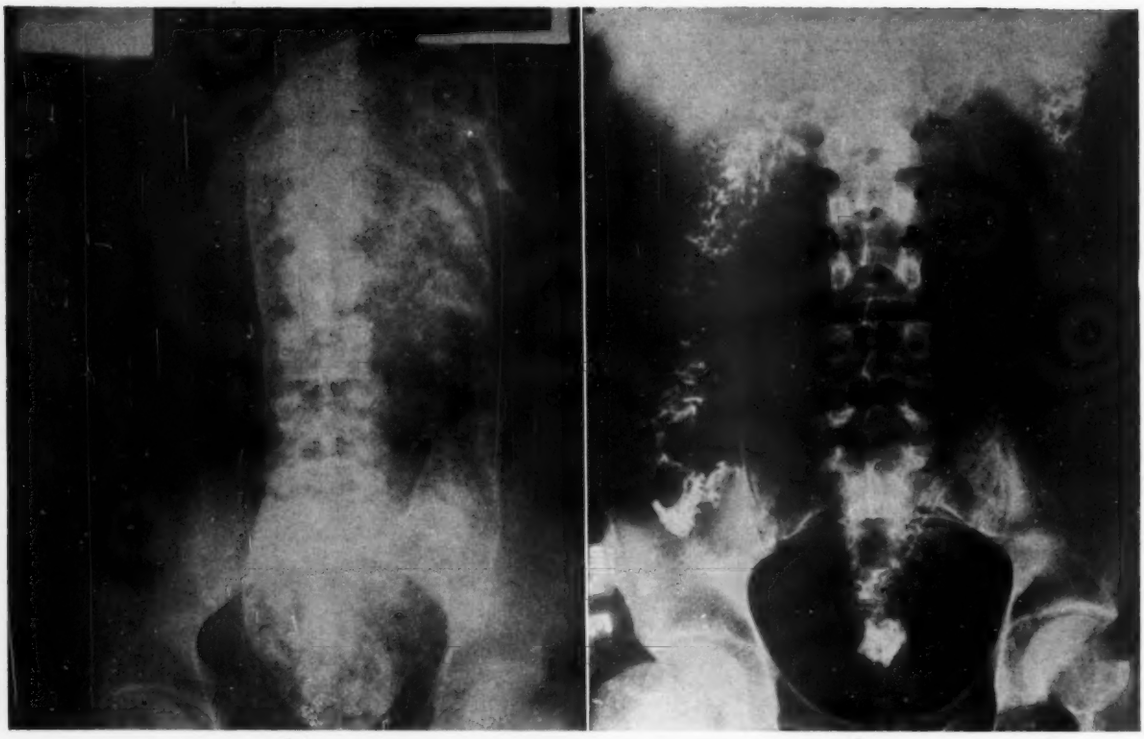
Dissection of the rectum is done atraumatically, staying close to the bowel to avoid damage to any pelvic structures, and is carried down to the levators, leaving the sphincter mechanism intact. This part of the operation must be performed with care or permanent injury to the anal and bladder sphincters may occur. We have been fortunate in not encountering these complications. However, personal communications to one author (O. S.) have reported such difficulties.

The operative team is now divided and the perineum exposed. The anal sphincter is dilated and a long clamp inserted through the anus up to the closed end of the rectosigmoid. (Fig. 3A.) This is grasped and the bowel turned inside out as it is drawn down. (Fig. 3B.) This mucosa-covered segment is then scrubbed with zephiran-soaked sponges and the perineum is draped. The everted segment is opened 2.5 cm. from the sphincter (Fig. 3C) and a long clamp is inserted through this into the pelvis. The closed proximal segment of bowel is grasped by this clamp and pulled down, being careful not to rotate this structure as it is brought out below. (Fig. 4A and B.) The anastomosis is made, using first a row of interrupted silk sutures to approximate the muscular coats. (Fig. 4C.) As these sutures are placed, the remainder of the distal bowel is cut across. With the first row of sutures completed the proximal bowel is opened and the mucosa of the two segments approximated with interrupted catgut sutures. (Fig. 5A to C.) When the anastomosis is finished, it retracts into the pelvis 2.5 cm. above the sphincter. While the anastomosis is being performed below, the team above reconstructs the pelvic floor and closes the abdominal wound. The use of two operating teams during the second half of the operation results in a considerable saving in operating time.

As a group the patients have tolerated the operation well and postoperative complications have been few. An ileal fistula and obstruction developed in one three week old infant. A secondary operation was performed, the perforation closed and the obstruction relieved. Six weeks later agranulocytosis appeared, with subsequent death. Another patient showed a fistula from the suture line which gradually healed in without later difficulty. This two and a half year old boy had a colostomy performed at an outside hospital before being referred to us. All the colon beyond the colostomy was narrow from disuse and we could not make a diagnosis of Hirschsprung's disease. The colostomy was closed and the patient carefully followed up. Three months later a typical rectosigmoid lesion of Hirschsprung's disease was evident. While we awaited further demarcation of the lesion the patient suddenly became obstructed and attempts to clean out the bowel were unsuccessful. At operation we were able to break up the impaction in the sigmoid and resection was considered to be feasible. Attachment of the colon to the abdominal wall at the site of the closed colostomy prevented mobilization of a sufficient length of bowel, and the anastomosis performed from below was under great tension with the posterior row of sutures incomplete. Although colostomy was indicated, further operative manipulation at the time seemed inadvisable because of the poor condition of the patient. He did so well subsequently that proximal decompression was not necessary. This boy has been followed up for a year and continues to be normal in his bowel functions. There have been no other infections at the suture line in this group of patients.

Urinary tract complications were uncommon. In one patient cystitis developed one week postoperatively, which responded well to penicillin. Two patients with atonic bladder following operation had difficulty in voiding. Three weeks postoperatively these patients were voiding normally. This experience has taught us that all patients must be on bladder drainage for ten days postoperatively.

In nine infants gastrointestinal upsets of unknown etiology were a postoperative problem. Vigorous treatment was required in three to combat dehydration and distention. Colonic irrigations in conjunction with supportive therapy were utilized, and symptoms usually



6A 6B

FIG. 6. A, preoperative barium enema in a twenty-eight year old male with severe Hirschsprung's disease; B, postoperative barium enema in same patient taken one month after a one-stage resection.

subsided in three to five days. These patients have since done well. Fortunately such difficulties are not encountered in children over three years of age.

Two patients became constipated twelve months postoperatively during a vigorous bowel-training program. Less insistence on bowel training in these youngsters resulted in prompt correction of their trouble without resorting to the use of enemas or laxatives.

There has been one recurrence in an infant two months after an inadequate resection. A 10-cm. aganglionic segment was left behind. This infant died following a secondary resection.

Three patients had strictures at the line of anastomosis adequately treated with simple operative division and subsequent digital dilatation. One patient needed revision of a pelvic floor which impinged on the new rectosigmoid. Six patients had slight strictures of their suture line which were corrected with dilatation. The majority of these patients were infants with a preliminary colostomy. Consequently, at the time of resection colon of no more than 2 cm. in diameter was brought down for anastomosis. As a result, after the anastomosis was completed, the stoma admitted only the index finger. It is for this reason that colostomy is best avoided, and if utilized should be followed in four to eight weeks with resection. Colostomy closure should be performed two to three weeks after removal of the rectum and rectosigmoid.

Some of the patients have been followed up for as long as three years. The results have been gratifying, with follow-up barium enema showing return of the dilated bowel to normal caliber and complete emptying. (Fig. 6.) Spontaneous daily bowel movements, gain in weight and improvement in general health have occurred in every case.

It is encouraging to note that Stephens,[29] Hiatt[30] and Koop[31] have corroborated these findings, using our technique[32] with minor innovations of their own.

SUMMARY

1. Diagnosis and treatment of sixty-nine patients with Hirschsprung's disease have been reported.

2. The basic pathology has been shown to be an aganglionic segment of distal large bowel which, lacking peristalsis, obstructs the normal evacuation of feces and gas.

3. The type of resection employed in correcting this obstruction in sixty-nine cases is described, with satisfactory results in sixty-seven.

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Practical Surgical Suggestions

GUILLOTINE AMPUTATION OF THE FINGER TIPS

AN IMPROVED METHOD OF TREATMENT

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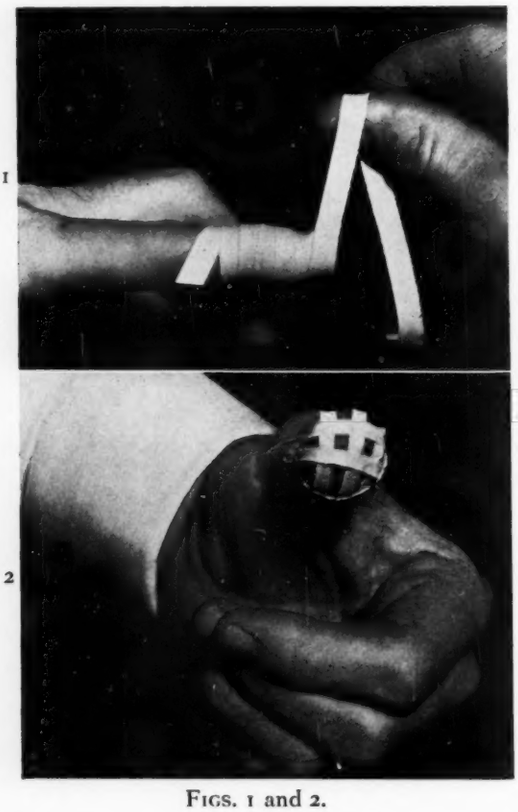
AN improved and simplified technic of handling guillotine amputations of the finger tips is presented. The method is recommended for traumatic guillotine type amputations of the digits below the mid-level of the distal phalanges.



FIGS. 1 and 2.

The previous procedures employed were the use of split skin grafts and the use of pedicle type grafts swung from the palmar aspect of the distal phalanx to cover the finger tip. Both these procedures leave secondary defects, require more operative maneuver and leave inferior results.

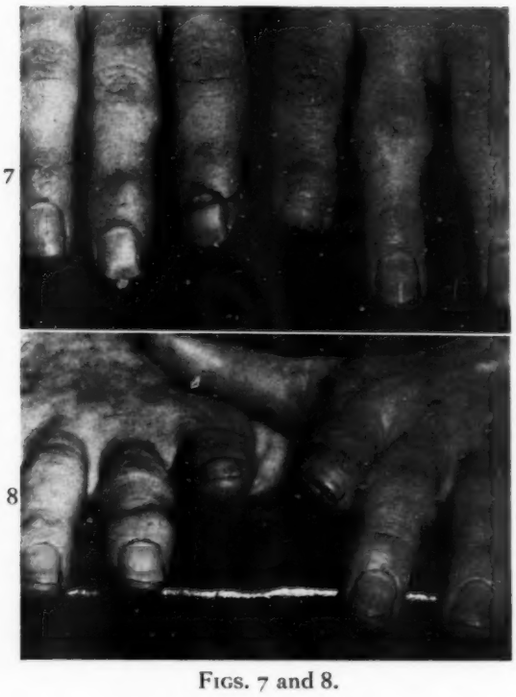
The method presented herein was suggested by the use of the banjo splint with rubber band traction to lengthen soft tissue parts of the stump. In an original case the difficulty of living and working normally with the cumbersome banjo traction splint suggested the method of accomplishing the same results with a tight adhesive tape spiral wrapped tightly to stretch soft tissue toward the end of the finger. (Fig. 1.) The desired result after repeated dressings with the tight spiral is a thickened pad of granulation tissue. The well known principle of promoting epithelization by using a "lattice" of very narrow adhesive tape straps is then used. (Fig. 2.)

FIGS. 3 and 4.

5

6

FIGS. 5 and 6.



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8

FIGS. 7 and 8.

To give more detail, the procedure to be followed when a fresh immediate guillotine amputation is seen is as follows: Bleeding is arrested by ligation of vessels and the stump is dressed with petrolatum gauze. After three to seven

9

10

11

FIGS. 9, 10 and 11.

days the spiral of tape strip is begun and reapplied two or three times weekly for about two weeks. This step is moderately painful to the patient. When the pad of granulation is formed over the raw bone surface, the use of "lattice" or "grill" straps of adhesive is begun. This step may overlap the use of the spiral strip by several days. By this time the area is always more or less septic and this causes no harm; in fact at times we believed the presence of some sepsis with resulting irritation actually stimulated epithelization. The third and fourth weeks the stump is dressed with the "grill" or "lattice" strips alone. Usually by the end of the sixth week at the latest the stump is cleanly healed and needs only olive oil massage.

Figures 3 to 11 are presented as end results. Figures 3 and 4 illustrate a case in which the end of the index finger was mashed off just below the nail bed root. The inked levels on the patients'

uninjured finger show the level of amputation on the injured finger; the opposite figure shows the end result. This case took thirty days of active treatment. Figures 5 and 6 show the level of amputation of a thumb marked on the uninjured thumb and the result on the injured digit. This was a power saw injury, and the treatment was continued over a sixty-day period. Figures 7 and 8 show the level of amputation and end result on an index finger instantaneously ground off on an emory wheel. Treatment covered five weeks. Figures 9, 10 and 11 are the only before and after pictures in the series. The injury involved the index and middle fingers, the injury to the middle finger being the more severe and causing bone loss. Figures 10 and 11 show the results after six weeks.

All four cases presented were amputations with bone loss and were guillotine type traumatic amputations. The treatment was simple and ambulatory and therefore inexpensive. The men lost no time from work because of the simplicity of dressing and avoidance of general anesthesia, and therefore were much happier people to deal with when time came for settlement of disability. The men in this group were tremendously pleased with their thick, nontender scar with normal skin and their excellent cosmetic result.

We believe the method presented is superior in dealing with guillotine amputations of the finger tips in simplicity, lack of expense or time lost and in end result. Gross infection of the stump was always present by the third week but tended to be helpful. No effort was made to sterilize the adhesive tape strips used. The method is particularly convenient in industries large enough to provide dispensary dressings at two- to three-day intervals.

CLINICAL APPLICATION OF THE LEHV HEADLESS SCREW*

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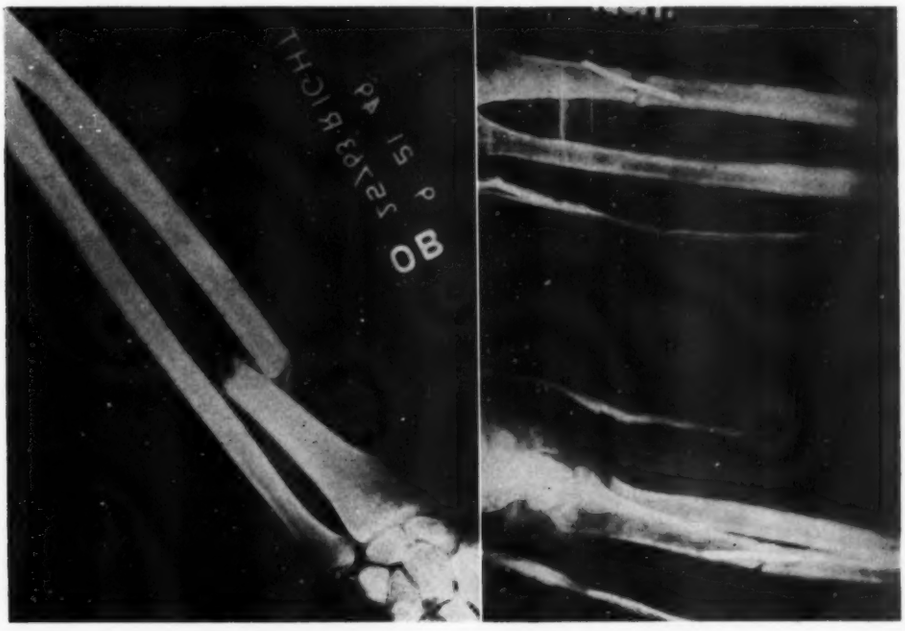
THERE is general agreement that in the treatment of fractures there is no substitute for adequate reduction and immobilization. When open reduction is indicated the fragments are in present practice maintained by one or more of the following appliances: plates, bands, screws, wires, intramedullary nails or grafts, each being selectively proper for the presenting type of fracture.

To simplify the adequate fixation of shaft fractures and to obviate the complications of plating, a new method of internal fixation by transfixion is presented. This method consists of the application of a self-drilling, self-tapping metal screw previously described by the senior author.[1] This apparatus justifies its existence by (1) shortening the operating time, (2) achieving firm fixation, (3) minimizing residual foreign material, (4) being inert and resisting corrosion, (5) being technically simple and (6) minimizing denudation of periosteum.

In this paper is presented the clinical application of this screw in twenty-six patients treated at Harlem Hospital, New York, New York.



1A 1B

FIG. 1. Case IV, patient T. D. A, September 21, 1949, transverse fracture of radius; B, November 16, 1949, approximately two months postoperatively, with one No. 6 screw.

PROCEDURE

After adequate exposure and reduction of the fracture, counter pressure is applied by Lowman clamps insuring absolute immobility of the fragments. Transfixion is then accomplished by drilling the screws through the bone fragments in a direction as nearly perpendicular to the line of fracture as is possible until the opposite cortex is pierced. After two or more screws are placed, the clamps are released and the reduction checked. If reposition is satisfactory, the protruding ends of the screws are clipped close to the cortex and the field closed.

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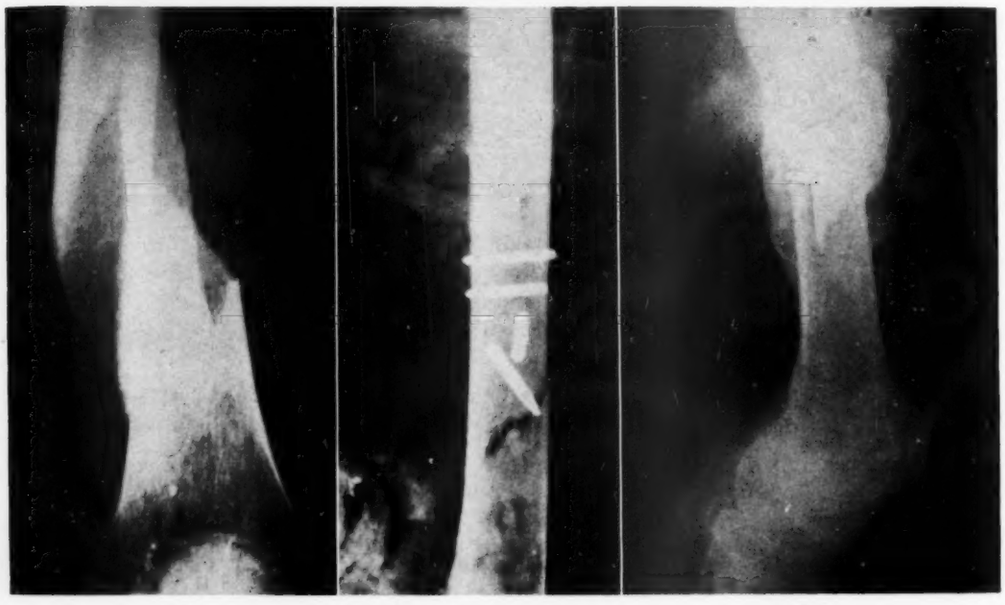
2A 2B

FIG. 2. Case VI, patient A. W., A, September 24, 1949, longitudinal fracture of external condyle of tibia; B, December 21, 1949, approximately three months postoperatively.



3A 3B 3C

FIG. 3. Case VII, patient E. C. A, October 12, 1949, spiral oblique fracture of femur; B, October 19, 1949, one week postoperatively, C, December 23, 1949, approximately two months postoperatively.

Certain modifications of the standard methods of bone drilling were necessitated and are described herein. To avoid bone burn necrosis and preclude the loss of thread security, drilling was slow and steady. If for any reason the drilling was interrupted, it was somewhat difficult to to get started again. In that event backing off two or three turns unfroze the screw. After the entrance cortex was pierced, the screw went in smoothly until the exit cortex was reached. This was recognized by some added resistance, and with a little added pressure at this time it was easily penetrated. The degree of penetration was checked by direct

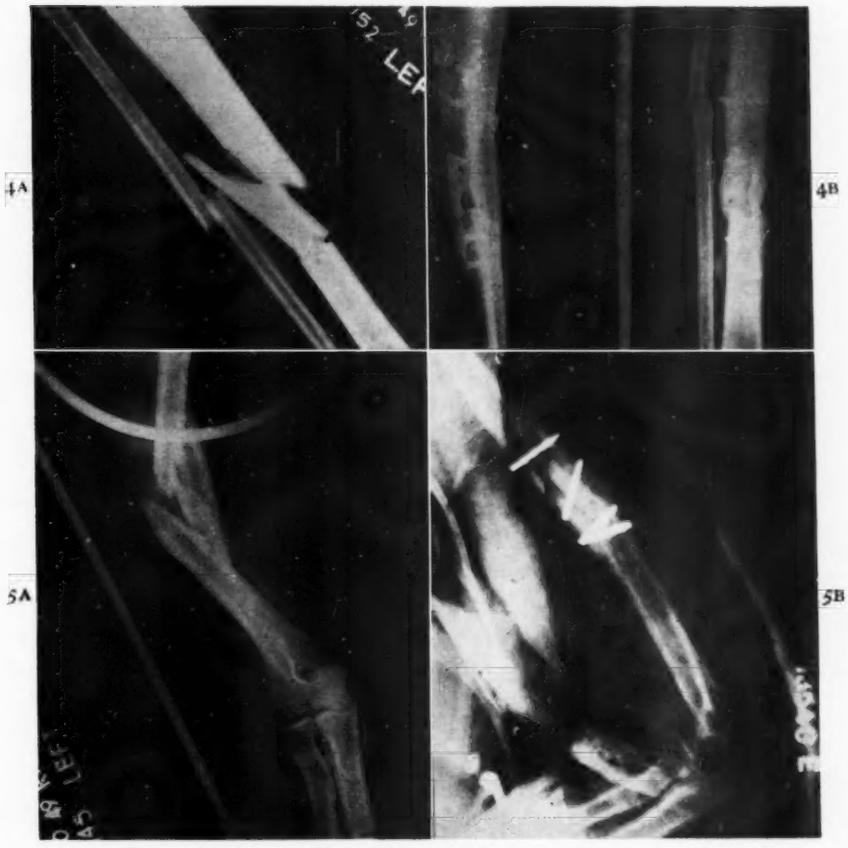


FIG. 4. Case X, patient J. M. A, November 3, 1949, blowout compound comminuted fracture of tibia; B, April 17, 1950, evidence of resorption below plate; screws firm.

FIG. 5. Case XVIII, patient O. J. A, December 30, 1949, severe comminuted fracture of left humerus; B, May 1, 1950, four months postoperatively.

vision if the exposure allowed for it, by fingertip palpation or by instrument contact. With experience it was learned that after the exit cortex was pierced, two to three additional turns gave proper protrusion.

It was often necessary to insert the screws at an angle. Our experience has shown that the maximum angle at which it can be applied is 50 degrees to the cortex. To insert the screw obliquely it was necessary to introduce it at right angles to the bone and then rotate it gradually while drilling to the proper emplacement. Whenever possible the screws were placed at different angles and at different levels to afford greater stability, for as the angulation is increased more cortex is engaged and the increased surface accepts a greater number of threads.

When the exit cortex was pierced, we occasionally encountered a mild splintering. This must be borne in mind when transfixing a long thin bone fragment. To avoid fragmentation it was found advisable to fix the thin fragment onto the larger one. Three sizes of screws were used, namely, $\frac{6}{32}$, $\frac{8}{32}$ and $\frac{10}{32}$ depending upon the thickness of the cortex and the amount of anticipated stress. We have found 3- and 5-inch lengths adequate for all of our cases.

The twenty-six operated cases reported herein involved (1) tibial shaft in fourteen cases, (2) tibial plateau in three cases, (3) femoral shaft in three cases, (4) radius in two cases, (5) humerus in two cases, (6) ulna in one case and (7) ankle in one case.

Table 1 is an itemization of these cases with x-ray and clinical results. (Figs. 1 to 5.)

COMMENTS

Our experience has shown that this screw is well suited for those cases in which transfixion

TABLE I

Patient	Age (yr.)	Date of Injury	Type of Fracture	Operation	Result
Case I T. B.	36	3/31/49	Comminuted spiral oblique fracture lower third right tibia; associated fracture of fibula	4/25/49, Lane plating held with No. 6 screws secured with nuts	1/26/50, x-ray showed good position; patient ambulatory
Case II I. B.	37	8/17/50	Comminuted transverse and oblique fractures lower third tibia and fibula	8/22/49, Lane plate with 3 No. 6 screws for transverse fracture and oblique fragment transfixed with 1 No. 8 screw	2/20/50, x-ray showed good position; moderate callus
Case III F. M.	31	9/4/49	Spiral oblique fracture junction of lower and middle thirds of left tibia; associated fracture of fibula	9/14/49, transfixion with 2 screws (1 No. 6 and 1 No. 8)	1/9/50, x-ray showed excellent position; callus
Case IV T. D.	30	9/23/49	Simple fracture right radius with marked displacement	9/26/49, reduction with single No. 6 screw	11/16/49, x-ray showed good position; strong callus
Case V T. C.	38	9/24/49	Complete fragmentation of lower third of right tibia with T fracture into the joint; associated double fracture of fibula	T fracture held with one No. 8 screw; posterior fragment held with No. 6 screw	3/22/50, x-ray showed stabilization; posterior bowing deformity
Case VI A. W.	28	9/24/49	Split fracture left tibial plateau with ½-inch displacement of lateral condyle	9/28/49, reduction with 2 No. 8 screws	12/21/49, on x-ray fracture line not visible; callus present
Case VII E. C.	71	10/12/49	Spiral oblique fracture at third junction of middle and lower third of right femur with marked rotation and displacement	10/17/49, reduction with 4 No. 8 screws	12/23/49, on x-ray good position; firm callus; patient ambulatory
Case VIII W. M.	24	9/19/49	Spiral oblique fracture right femur, junction of upper and middle third with lateral displacement of proximal fragment	Transfixion with 2 No. 8 screws	12/28/49, on x-ray extensive callus; patient ambulatory
Case IX G. H.	37	10/29/49	Severely comminuted supracondylar fracture of left humerus with fragmentation, impaction and dislocation of multiple fragments	Reduction with good alignment held with 2 No. 6 screws and single wire loop	11/28/49, on x-ray good function; moderate callus
Case X J. M.	71	11/3/49	Comminuted compound fracture middle third left tibia; associated fracture of fibula	Reduction with fixation of proximal fragment to central blowout fragment with 2 screws (1 No. 6 and 1 No. 8); Lane plating of transverse fracture	4/17/50, on x-ray some sequestration; moderate callus
Case XI C. F.	50	11/17/49	Bimalleolar fracture left ankle with subluxation of foot and separation of joint ankle mortise	12/1/49, 1 No. 8 screw through tibia and fibula to re-establish ankle mortise	3/31/50, on x-ray anatomic position
Case XII H. J.	29	11/24/49	Compound fracture middle shaft right radius and simple fracture ulnar styloid	11/25/49, reduction and fixation by single No. 6 screw	1/10/50, on x-ray good alignment, firm callus
Case XIII I. H.	35	12/2/49	Comminuted compound transverse fracture of middle third right tibia and fibula	12/29/49, transfixed with 2 No. 8 screws	4/26/50, on x-ray good position; callus; false motion; infection

TABLE 1 (*Continued*)

Patient	Age (yr.)	Date of Injury	Type of Fracture	Operation	Result
Case XIV L. L.	36	12/18/49	Extensive shatter fracture of tibial plateau with 1¼-inch displacement of lateral fragment beyond lateral condylar margin	12/22/49, incomplete reduction achieved; 12/24/49, satisfactory reduction	4/20/50, on x-ray good position
Case XV F. T.	52	12/19/49	Comminuted fracture lower third right tibia and fibula	12/22/49, reduction with 4 No. 8 screws	4/14/50, on x-ray good alignment; extensive callus
Case XVI J. O'B.	41	11/28/49	Spiral oblique fracture junction of lower and middle thirds left tibia; associated fracture of fibula	12/23/49, reduction with 3 No. 8 screws	Infected; 1/23/50, on x-ray good position; callus present
Case XVII M. T.	31	12/27/49	Complete separation right olecranon of ulna	12/29/49, reduction with 1 No. 8 screw	12/29/49, on x-ray repositioned
Case XVIII O. J.	29	12/30/49	Comminuted fracture middle third left humerus	1/16/50, reduction with 4 No. 6 screws	5/1/50, on x-ray excellent position; callus
Case XIX M. T.	44	1/2/50	Fractured left tibial plateau	1/10/50, reduction with 2 No. 10 screws; screws removed after 2 mo.	5/31/50, on x-ray excellent position; callus formation; good range of motion
Case XX W. H.	47	1/3/50	Comminuted fracture upper third left tibia and fibula	1/12/50, reduction with 3 No. 8 screws	3/29/50, on x-ray fragments in good alignment; callus
Case XXI M. G.	41	1/14/50	Fracture right tibial plateau	2/3/50, reduction with 2 No. 8 screws	3/20/50, on x-ray good position; no callus noted through cast; crutch paralysis
Case XXII L. M.	30	2/28/50	Compound spiral oblique fracture lower third right tibia and fibula	3/31/50, 4/3/50, reduction with 3 No. 8 screws	4/4/50, on x-ray excellent position
Case XXIII M. F.	50	3/13/50	Spiral oblique fracture lower third right tibia with lateral displacement of distal fragment	3/20/50, reduction with 2 No. 8 screws	5/24/50, on x-ray good position; complete bone union
Case XXIV E. W.	27	3/25/50	Spiral oblique fracture lower third left tibia and fibula	4/14/50, reduction with 2 No. 8 screws	4/17/50, on x-ray excellent position
Case XXV M. J.	42	1/14/50	Compound comminuted fracture left tibia and fibula	4/14/50, Lane plate for transverse fracture; plate held with 5 No. 6 screws; fixation of oblique fracture with 2 No. 8 screws	6/7/50, on x-ray good position
Case XXVI S. P.	27	4/13/50	Spiral fracture middle third tibia; associated fracture of fibula	4/18/50, reduction with 4 No. 6 screws	4/20/50, x-ray excellent position

is the method of choice. It has its greatest field of application in spiral oblique shaft fractures. It has been found extremely useful in tibial plateau fractures and fractured and dislocated malleoli and the olecranon. In many cases it has obviated the necessity for plating operations. It is not, however, recommended for highly comminuted or for transverse fractures because of technical difficulties in holding the reduction while introducing the screw. When the screws can be placed perpendicular to the bone, flat-slotted washers which replace the usual screw heads have been used on each end to add additional security. When the screws must be placed oblique to the cortex in tibial plateau fractures, the structural nature of the bone allows for the use of these washers which have proven most helpful. In conjunction with nuts or slotted washers plating procedures are facilitated by the use of these screws. They eliminate separate drilling operations, prevent breakage of drills and insure immediate proper placement of screws of proper length through bone of varying diameter.

SUMMARY AND CONCLUSIONS

1. The clinical application of a self-drilling, self-tapping screw is presented.

2. The operative procedure is described and the results tabulated.

3. In this series of twenty-six cases presented operative time has been shortened and many plating procedures avoided.

4. On the basis of observations to date we believe that the self-drilling, self-tapping bone screw has a wide application in the field of traumatic bone surgery and merits consideration and further study.

Acknowledgment: The authors wish to thank Dr. Louis T. Wright for his cooperation and helpful suggestions.

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Some 150 authentic cases of patients with an aneurysm of the pulmonary artery have been reported to date. Syphilis and/or congenital heart disease were present in over half of the patients. Chest pains, cough and dyspnea are common clinical symptoms. Cyanosis and edema due to cardiac failure may occur later. Chest films show a suggestive, pulsating hilar mass close to but distinct from the aorta. Surgical cure can be effected by ligation of the right pulmonary artery and pneumonectomy. (*Richard A. Leonardo, M.D.*)

Case Reports

NON-TRAUMATIC RUPTURE OF THE COMMON BILE DUCT*

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SINCE non-traumatic, spontaneous rupture of the common bile duct is rare, it would seem that every authentic case should be reported. Ruptures of the common bile duct have been reported from time to time and the clinico-pathologic features presented. The etiology may be associated with calculi, acquired or congenital stricture of the common bile duct, malformations (congenital cystic dilatation), infection and tumors.

The general incidence of common duct perforations relative to the remaining portion of the bile duct system may be appreciated in the figures of McWilliams.[1] In a survey of ninety cases of spontaneous rupture of the biliary tree only four (4.4 per cent) were found in the common duct.

In 1930 Bailey[2] recorded a case of spontaneous perforation of the common bile and in 1932 Vale and Shapiro[3] reported a non-traumatic perforation of the common bile duct. In 1941 Newell[4] recorded a case of bile peritonitis incident to an acute spontaneous rupture at the common bile duct. Additional cases have been recorded by several authors.[5–22]

Traumatic rupture of the choledochus is a very rare entity. In 1948 Hicken and Stevenson[23] reported a case.

Our two cases of non-operative rupture of the common bile duct follow:

CASE REPORTS

CASE 1. A white female, age forty-five, Case No. 180737, was admitted to the hospital on November 6, 1948, and she died on November 11, 1948. The chief complaint was right upper quadrant pain.

The patient had been in fairly good health until three days ago when she noticed soreness and a dull pain in the right upper quadrant. This pain, colicky in type, gradually became more severe, especially at night. It remained in the right upper quadrant; no radiation was noted. There was nausea but no vomiting. The urine was dark but the stools were normal. No chills, fever or jaundice were noted. Since the onset of the illness the patient had been slightly dyspneic.

Past history revealed the patient had had recurrent attacks of right upper quadrant pain for six years, the frequency, duration and severity of the attacks increasing with time. A definite relation to the indigestion of fatty or greasy foods was elicited. There was no history of icterus, clay-colored stools, hematemesis, melena, constipation or diarrhea. The attacks were not severe enough to require hospitalization.

Except for mild dyspnea on exertion the remaining past history was not significant.

On physical examination the temperature was 100°F., pulse 72, respirations 15 and blood pressure 116/70. Positive findings included slightly icteric scleras, marked tenderness in the right upper quadrant beneath the costal margin, voluntary rigidity and a positive Murphy sign. No abnormal abdominal masses were felt. Otherwise, the examination was not remarkable.

Laboratory data were as follows: a blood count revealed the hemoglobin to be 14 gm. per cent, red blood count 4.87, white blood count 9,500 with a differential of 68 per cent polymorphonuclears, 19 per cent stabs, 1 per cent metamyelocytes, 8 per cent lymphocytes, 3 per cent monocytes and 1 per cent eosinophils. Icterus index was 19 units. Urinalysis revealed the presence of bile and a trace of albumin.

On admission treatment consisted of intravenous fluid, a fat-free diet, vitamin K and morphine as needed. Since the clinical condition was becoming worse, the senior

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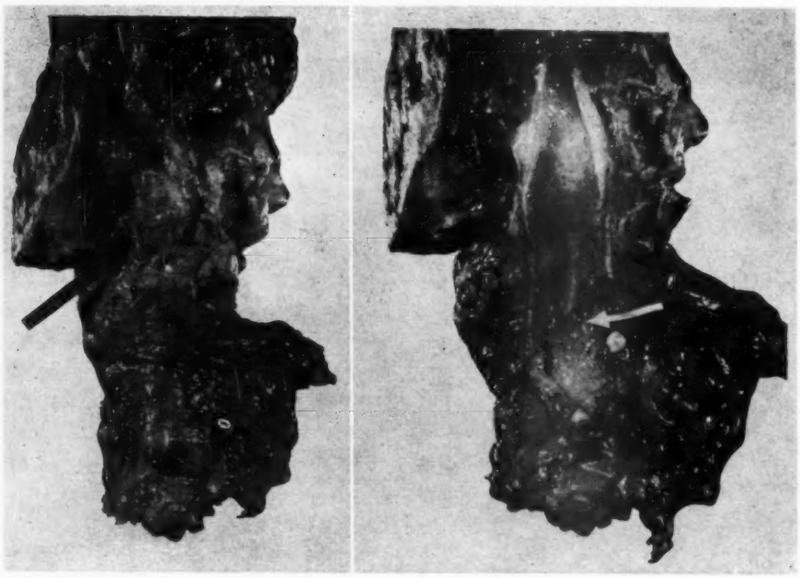

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FIG. 1. A perforation 3 mm. long is shown 4 cm. above the ampulla of Vater.
FIG. 2. Longitudinal opening of the common duct shows area of perforation.

surgeon advised immediate operation which was performed forty-eight hours after admission.

Under sodium pentothal® induction and cyclopropane anesthesia an upper right rectus incision was performed. Upon opening the peritoneal cavity approximately 700 cc. of free bile were found. Careful examination disclosed four facetted yellow calculi, each 4 mm. in diameter, in Morrison's pouch. The gallbladder was markedly injected and distended; plaques of exudate were noted. Gentle palpation of the common duct produced three other calculi of similar nature. However, the surgeon, at the time, thought the calculi had escaped from a necrotic zone in the neck of the gallbladder. The latter was removed. At this time the patient's condition was extremely poor; therefore, a split, hard, rubber drain was placed in the common duct and a Penrose drain in Morrison's pouch. The abdominal wound was closed in the usual manner.

The pathologic report revealed acute purulent exacerbation of a chronic cholecystitis, no evidence of perforation and thirty facetted calculi (3 to 10 mm. in diameter) of mixed pigment type.

The postoperative course was exceedingly stormy. The patient received intravenous fluids, including amigen, blood and plasma; the usual supportive measures were given. In addition, penicillin and streptomycin were administered. However, the patient's condition grew steadily worse. On November 10th the lower portion of the abdominal wound was opened, allowing a large amount of bile to be evacuated. The patient's condition was such that further operative procedures were inadvisable. The patient expired ten hours later.

From the postmortem examination the significant findings may be presented as follows: The peritoneal cavity contained approximately 1,000 cc. of yellow, bile-colored fluid. The parietal and visceral peritoneal layers contained a yellow fibrinous-like exudate. The intestinal loops were moderately edematous and bound together by fresh fibrinous adhesions which were easily broken. The liver extended 4 cm. below the costal margin in the mid-clavicular line. Its surfaces were covered by a shaggy bile-stained exudate. The liver itself weighed 1,390 gm. The hepatic parenchyma was reddish brown in color, friable in consistency and the lobular pattern was faintly visible. There was a free ooze of blood from the cut surfaces. The intrahepatic ducts were slightly dilated and patent.

Examination of the gallbladder bed revealed a gelfoam pack in this area. The cystic duct had been doubly ligated approximately 1 cm. from the common bile duct. Examination of the common and major hepatic ducts revealed

considerable dilatation. The common bile duct varied from 1 to 1.3 cm. in its luminal diameter. All extrahepatic ducts with the portal vein and hepatic artery were embedded in markedly edematous, bile-stained connective tissue and fat. Careful dissection of the common duct revealed a 3 mm. perforation on the posterior aspect approximately 4 cm. above the ampulla of Vater. (Fig. 1.) A small sinus extended upward nearly to the origin of the cystic duct and this passage contained three facetted yellow calculi each measuring 3 mm. in diameter. Upon gently milking the common duct three similar calculi were extruded through the perforation into the sinus described before. In addition, there was a free passage of bile. Then the common duct was opened longitudinally revealing the area of perforation. (Fig. 2.)

The mucosa itself was smooth and yellowish brown in color, and no obvious exudate was present. However, at the site of perforation the edge of the mucosa was rough and irregular. Further inspection revealed an 8 mm. greenish black smooth calculus, firmly embedded in the ampulla of Vater. (Fig. 3.) Considerable difficulty was encountered in its removal at the postmortem table. The portion protruding into the duodenum was brownish black in color while the portion within the duct was greenish brown in color. No significant abnormalities were encountered in the major hepatic ducts.

Histopathologic study of the common bile duct disclosed a subacute inflammatory process in which the greater portion of the mucosa was intact. At the site of perforation, however, there was necrosis with a rather intense inflammatory reaction and complete disintegration of the wall. (Figs. 4 and 5.) Apparently the rupture was due to pressure necrosis by a calculus and increased intraductal pressure. Study confirmed the presence of bile peritonitis and septic peritonitis due to Escherichia coli. The liver disclosed some middle and central zonal necrosis associated with bile stasis. Moderate parenchymatous degeneration of the myocardium and changes of terminal vascular failure were noted.

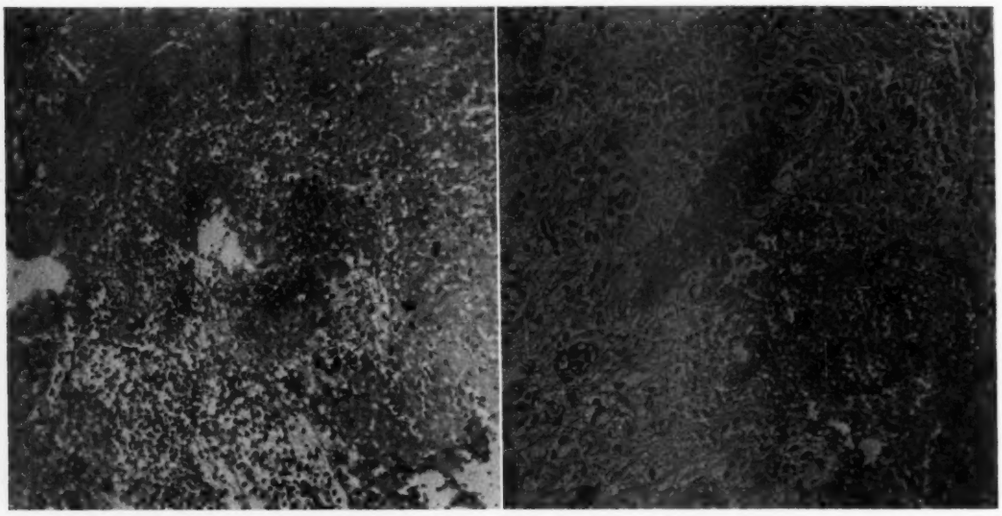
Comment. Clinically, such a case represents an acute abdominal emergency requiring closure of the perforation and adequate peritoneal drainage supplemented with good supportive measures. In this case there was a forty-eight-hour observation period prior to surgical intervention. Further, the opening in the common bile duct was in a posterior position and not recognized. A fatal outcome ensued.

FIG. 3. Greenish black calculus 8 mm. embedded in the ampulla of Vater.

CASE II. A white female, age forty-eight, Case No. 208220, was admitted to the hospital in September 30, 1949, and was discharged on October 20, 1949.

The chief complaint was right upper quadrant pain. The patient had been in excellent health until September 27, 1949. At 10:00 P.M. she had eaten a meal of chop suey and some twenty minutes later experienced epigastric distress associated with frequent belching. The following day right upper quadrant pain developed which radiated to the right and infrascapular area. The pain was colicky in type and became progressively severe. There was some nausea and vomiting. No jaundice was noted. No previous similar episodes or history of gallbladder disease was elicited.

Physical examination disclosed generalized abdominal tenderness, rigidity, rebound tenderness and a positive Murphy sign. The senior



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FIGS. 4 and 5. Necrosis of the wall, intense inflammatory reaction and complete disintegration.

surgeon's impression was that of acute cholecystitis with positive rupture of the gallbladder. Appendicitis with perforation and peritonitis was considered.

The significant laboratory data on admission may be outlined as follows: red blood count 4.20, hemoglobin 12.9 gm. per cent, white blood count 15,400 with a differential of 75 per cent polymorphonuclears, 10 per cent stabs, 12 per cent lymphocytes, 3 per cent monocytes and 1 per cent eosinophils. Toxic granulation was evident.

The non-protein nitrogen was 28 mg., plasma chlorides 570 mg., carbon dioxide combining power 58 volumes per cent, total serum proteins 6.8 gm. with normal albumin-globulin ratio. Except for a trace of albumin no abnormalities were found in the urine.

The senior surgeon thought that immediate operation was indicated. Under general anesthesia of sodium pentothal® supplemented with nitrous oxide, a right rectus incision was made in the upper quadrant. Upon incision of the peritoneum approximately 1,000 cc. of a muddy, dark grey, bile-like fluid were encountered. No food particles were seen in this fluid. No areas of perforation were found in the duodenum or stomach. The gallbladder was hyperemic and markedly edematous; its wall was greatly thickened. The common duct was identified in a greenish, fibrinous exudate. Careful examination disclosed a 3 to 4 mm. perforation located in the anteromedial aspect 1 cm. distal to the junction with the cystic duct. The gallbladder was aspirated, but bile could not be obtained. The fundus was incised and forty firm, greenish black calculi were removed. These stones were of pigment type with some calcium salts; they varied from 2 to 5 mm. in diameter; the external outlines varied from round to oval to facetted. The common duct was explored and a probe entered the duodenum easily. Clear bile escaped from the perforated area in the common duct. The zone of perforation was enlarged and a T tube was inserted. A hard rubber drain was placed in the fundus of the gallbladder and a Penrose drain was tucked in the foramen of Winslow. The drains and T tube were brought out through a small incision lateral to the abdominal operative site. The peritoneum was closed with continuous plain catgut sutures. The anterior sheath of the rectus muscle was closed with interrupted figure of eight chromic catgut sutures. Subcutaneous tissues were approximated with plain catgut sutures and the skin closed with interrupted vertical mattress silk sutures. The patient returned to her room in good condition.

During the operation the patient received 1,000 cc. of 5 per cent dextrose in saline.

The immediate postoperative course was fairly good. Wangensteen drainage was used. On November 2, 1949, the temperature was still 103°F. The abdomen was slightly distended and generally tender. We thought that we were dealing with a bile peritonitis, with

or without secondary bacterial invasion. Therefore, the patient was given 300,000 units of penicillin per day and 250 mg. of streptomycin every three hours for the next eight days. Supportive intravenous fluids, including blood, plasma, Baxter's protein hydrolysate and vitamins, were used. During this period the temperature and pulse gradually returned to normal. The fluid and electrolytic balance was carefully followed with laboratory procedures. The drains were removed on November 8, 1949. On November 11th a cholangiogram failed to reveal calculi and the dye passed easily into the duodenum and cystic ducts. (Fig. 6.) The entire biliary tree was well outlined. The patient's condition steadily improved and she was discharged on her twentieth hospital day in excellent condition.

Comment. This case illustrates the results of prompt surgical exploration, evacuation of free bile, closure of perforation in the bile duct, good peritoneal drainage and adequate supportive measures. Plasma, whole blood and antibiotics must be used. Unless this regimen is followed, death may be expected in nearly all cases.

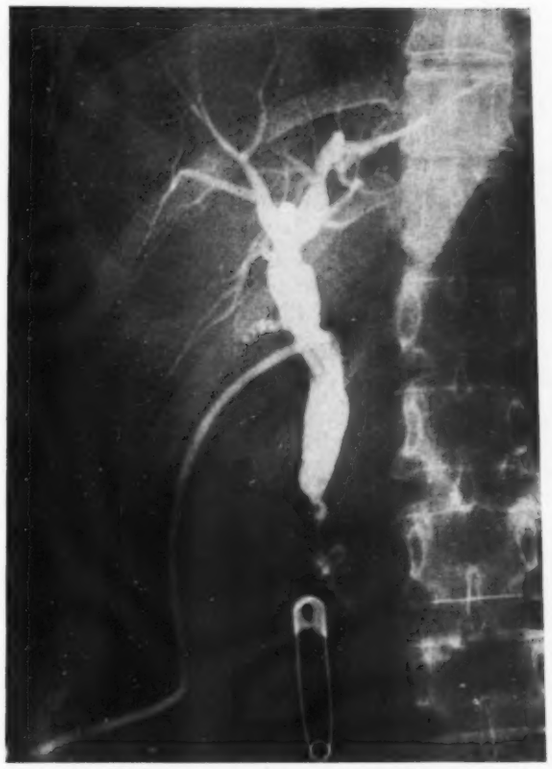

FIG. 6. Cholecystogram ten days after operation showed bile passages free of calculi.

REMARKS

Choledochal calculi are relatively frequent and represent the most important factor in perforation of the common bile duct. The source of these stones is somewhat controversial although their nature and character, except for size, are identical with those of calculi found within the gallbladder. Whether they arise entirely within the duct or represent deposits of crystals about a nidus expelled from the cystic duct, matters little here. The symptoms, signs and laboratory findings are essentially those of cholelithiasis with the added factors incident to varying degrees of obstruction to the bile flow. The treatment of the latter is fairly uniform, i.e., immediate relief of the obstruction by removal of the calculus or calculi. There have been instances in which failure to remove all calculi has resulted in postoperative ruptures in the biliary tract.

It is generally agreed by most writers that the following factors are important in the perforation of the bile duct system: (1) Increased intraductal pressure due to mechanical blockage by calculi, mucus plugs, tumors, parasites and stricture, or by reflex spasm of the sphincter of Oddi, or both; naturally, overdistention will result in perforation at the weakest point; (2) active cholangitis with necrosis of the ductal wall; (3) thrombosis of arterial or venous channels may lead to ischemic necrosis and perforation; calculi may or may not be associated; (4) activation of refluxed pancreatic juice into the common bile duct may produce tissue necrosis. This supposition seems unlikely in view of our present day knowledge.

Trauma to the duct from external sources such as falls and automobile accidents, direct wounds caused by knives and projectiles, upward traction due to shrinkage of the liver or downward traction by adhesions and carcinomatous invasion of the duct (carcinoma of the stomach or pancreas) are considered remote possibilities.

Rupture, traumatic or otherwise, of any portion of the ductal system or gallbladder leads to bile peritonitis.

McLaughlin, writing in 1942, lists a very complete and satisfactory classification of the possible factors in the etiology of bile peritonitis. Obviously, one of the causes is rupture

of the common bile duct. His conclusion that the vast majority are due to microscopic rather than gross rupture may be controversial. The role of calculi cannot be underestimated.

As in gallbladder disease the highest incidence is in the fifth decade or later. It is more common in the female than in the male, and there is an antecedent history highly suggestive of cholelithiasis.

Clinically, the condition is characterized by rapid onset, severe pain, often some degree of shock, frequently subclinical jaundice and obvious signs of peritonitis. Including those incident to recent surgery, either cholecystectomy with perforation of the cystic duct at its stump or a rupture of a sutured common or hepatic duct, the histories suggest gallbladder disease of a severe degree. Differentially, acute pancreatitis or a perforated peptic ulcer must be seriously considered. At operation free bile in fairly large amounts is found within the peritoneal cavity.

The disease is associated with a mortality of 50 to 70 per cent in most recorded series. It seems likely that the shock-like picture is in part at least due to a large fluid loss and marked electrolytic changes in the body. The use of antibiotics may be indicated since pathogenic organisms are not uncommonly recovered. The most frequent microorganisms belong to the Esch. coli group although hemolytic streptococci may be encountered.

SUMMARY

Two additional cases of spontaneous, nonoperative rupture of the common bile duct have been presented with a general review of the literature. Prompt recognition of this rare clinical entity is mandatory since operative intervention is imperative in these cases. When there is gross rupture of the common bile duct, the mortality is nearly 100 per cent if operative correction is not performed. Likewise, the postoperative supportive therapy with proper laboratory aids cannot be overemphasized.

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CONGENITAL HERNIA THROUGH THE DOME OF THE RIGHT DIAPHRAGM IN AN ADULT*

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RIGHT-SIDED diaphragmatic hernia in adults is a rare condition. In a series of 404 cases of diaphragmatic hernia treated surgically[1] only one was on the right side, with approved traumatic etiology. Sporadic reports of right-sided herniation, all on the basis of trauma, have been published.[2–4] The predominance of left diaphragmatic herniation on the basis of trauma is marked.[5]

The type of opening usually found in the diaphragm in traumatic herniation is slit-like, running radially from the central tendon to the chest wall.[3] This usually occurs even if the traumatic object is small, e.g., a bullet. Too, it has been noted[3] that the raw edges are conducive to adhesions.

In children, however, numerous reports of right-sided congenital diaphragmatic hernias have been published.[6–8] These congenital defects have been found to be either true sacculated hernias or false hernias with no peritoneal or pleural covering. The sites of these openings have been ably summarized by Harrington.[9]

CASE REPORT

The patient complained of "pain in the right upper abdominal quadrant and right anterior chest." He stated that he was well until six days previously when he began to experience epigastric and right upper quadrant pain. The following day his pain became more severe and constant. He developed nausea and began to vomit after each meal. The vomitus consisted of ingested food. There was no blood or "coffee ground" material. His stools, which were of a light brown color, were loose. Since onset his pain had increased and progressed, moving upward to the right anterior chest region. Respiration had become painful. There had been no coughing. His last bowel movement was two days previously and no flatus had been passed since that time. On admission the patient's most severe pain was at the level of the third intercostal space anteriorly on the right side.

The past history was irrelevant except for the history of a gun-shot wound incurred on August 11, 1945. At that time he was struck by a .45 caliber pistol bullet which had its point of entrance in the anterior abdomen about 4.0 cm. above the symphysis pubis in almost the exact midline and which coursed downward and slightly to the right, having its point of exit in the right buttock slightly to the right of the third sacral segment. An abdominal laparotomy was performed shortly after his injury and two perforations of the distal ileum and two of the bladder were found and closed by interrupted sutures of cotton. The abdominal cavity and the space of Retzius were drained and the bladder drained by indwelling catheter. His postoperative course was essentially uncomplicated and on September 7, 1945, he was discharged to convalescent furlough. On September 23, 1946, the patient was again admitted to an Army hospital with the clinical diagnosis of acute small bowel obstruction. At that time he complained of generalized abdominal pain, vomiting and abdominal distention. Conservative treatment was instituted, consisting essentially of continuous gastric suction and intravenous fluids to maintain his fluid and electrolyte balance. Three days after the beginning of this treatment the abdomen was soft and flat and normal bowel movements had been resumed. On October 11, 1945, he was medically discharged from the Army. Since that time he had remained symptom-free until the onset of his present illness.

Physical examination at this time revealed a well developed, well nourished thirty-four year old Latin-American male who was admitted as a stretcher patient in obvious acute distress. His temperature was 100°F., pulse 86 and

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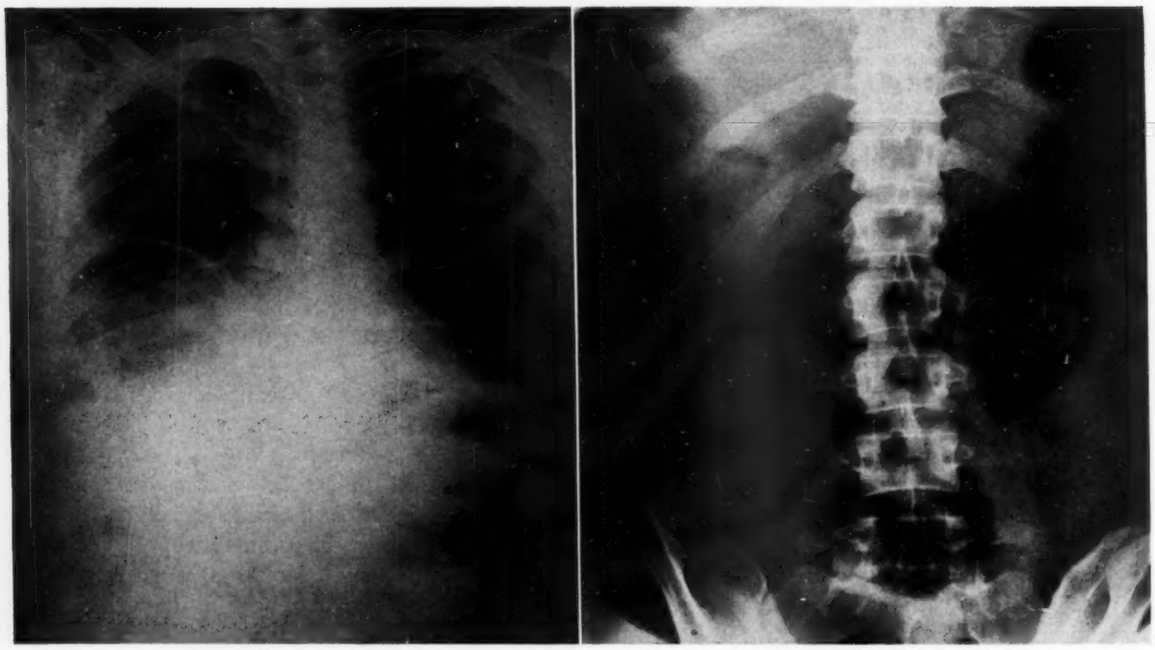

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FIG. 1. Shows what proved to be large bowel within the right thoracic cavity.
FIG. 2. Simple film of the abdomen revealing dilated intestinal loops and gas shadows, apparently intestinal, above the liver.

respirations 20. The general physical examination revealed nothing abnormal except for the chest and abdomen. Examination of the right chest revealed an absence of tactile fremitus below the third interspace on the right anteriorly. There was a tympanitic note to percussion below the third interspace anteriorly and this area of tympany extended laterally and posteriorly. Breath sounds were absent in this area. The left chest was normal. Abdominal examination revealed moderate distention. The abdomen was tympanitic throughout. There was tympany above the usual area of liver dullness. Peristaltic sounds were markedly diminished. There was moderate tenderness on palpation throughout the abdomen but muscle guarding was not present. The blood count revealed 7,400 total white blood cells and 5 million red cells. There were 13 gm. of hemoglobin per cu. mm. The differential white blood count showed 3 bands, 62 segmented neutrophils, 30 lymphocytes, and 5 monocytes. The urine was negative for albumin and sugar and showed no abnormal elements microscopically.

Radiographic examinations revealed the following findings: In the chest there was a convex line of homogeneous density extending from the axillary line to the lateral vertebral line at the level of the third anterior rib. This was 2 mm. in depth and appeared to be the diaphragm. Inferiorly, there was a homogeneous density which was probably intestine extending from the diaphragm to the superior surface of the liver 8 cm. below the diaphragm. No haustral lines were noted in this suprahepatic region. The rib spaces were slightly narrowed on the affected side. The cardiac contour was not shifted appreciably. Distended intestinal loops were seen in the left upper quadrant of the abdomen. The left lung was clear. (Fig. 1.)

A simple film of the abdomen revealed dilated intestinal loops, which were probably jejunal, extending from the left upper quadrant to the right lower quadrant. Gas shadows were noted over the hepatic area which probably represented small intestine. *Impression:* (1) Intestinal obstruction; (2) intestinal shadows above the liver. (Fig. 2.)

A barium enema was given. The barium flowed freely to the proximal transverse colon where it ascended for about 3 inches toward the loop of bowel under the right diaphragm. Complete obstruction was met at this point. The end of the barium column was smooth. After evacuation the mucosal pattern of the obstructed end was distorted, tapering off toward

the edge of the loop of bowel noted above the liver. *Impression:* Axial torsion causing a volvulus of the proximal transverse colon. *Probable etiology:* "Herniation" of the large intestine above the liver. (Fig. 3.)

The clinical impression at this time was that the patient had a non-strangulated intestinal obstruction, due possibly to a volvulus of the transverse colon, and probably directly related to the previous gun-shot wound of the abdomen. A conservative course was decided upon for the time being and a Levine tube was passed into the upper gastrointestinal tract and Wangensteen drainage instituted; adequate fluids were administered by venoclysis and prophylactic penicillin therapy was begun.

The following day the white blood count was 10,000 with bands 6, segmented neutrophils 68, lymphocytes 22, monocytes 4. His temperature was 102.4°F., pulse 114 and respirations 24. Abdominal examination revealed an increased amount of distention and absent peristalsis. The abdomen showed moderate tenderness throughout. The degree of right upper abdominal and right lower chest pain had progressively increased. Because of the progression of his symptoms and the development of signs indicative of probable intestinal strangulation, laparotomy was decided upon and the patient was taken to surgery nineteen hours following his admission to the hospital. Adequate amounts of compatible blood were obtained prior to surgery for transfusion as needed. The anesthetic used was spinal procaine which was supplemented in the terminal phases of the operation by nitrous oxide-ether.

The abdomen was entered through an upper right rectus incision. Examination of the abdominal contents revealed fairly marked dilatation of the small intestine and very marked distention of the cecum and ascending colon. The descending colon was collapsed. Further exploration revealed that the medial half of the transverse colon and the great omentum had herniated through an abnormal opening in the dome of the right diaphragm. This hiatus was slightly oval in shape with its long axis transverse and was approximately 2 by 3 cm. in size. It was situated in the tendinous portion of the right leaf of the diaphragm over the superior surface of the liver, slightly posterior to the mid-sagittal plane of the body and almost equidistant between the vertebral column and the lateral

FIG. 3. Barium enema revealing obstruction of the proximal transverse colon, interpreted as being due to volvulus of the colon with herniation above the liver.

margin of the thoracic cage. The large bowel was completely obstructed at the site of the opening through which it had herniated and the surgeon's little finger could be introduced through the opening alongside the herniated bowel only with considerable difficulty. There were no adhesions at the neck of the sac and the defect in the diaphragm had a smooth lining. The opening in the diaphragm was enlarged by an incision approximately 2 inches in length which extended medially in a transverse direction from the medial margin of the opening through which the herniation had occurred. After incision of the diaphragm and exploration of the thoracic cavity it was found that the loop of bowel which had herniated into the chest was greatly distended and markedly edematous, comprising a mass the size of a grapefruit, and that it was filled with semi-solid fecal matter and gas. The greater omentum extended superior, posterior, and medial to the herniated loop of bowel, being closely applied to the posterior chest wall near the mediastinum. This omentum was thick, edematous, hard and firmly adhered within the hernia sac. A true hernial sac was almost certainly present but was so densely adherent to the adjacent pleura in the thoracic cavity that positive identification was not possible. When reduction

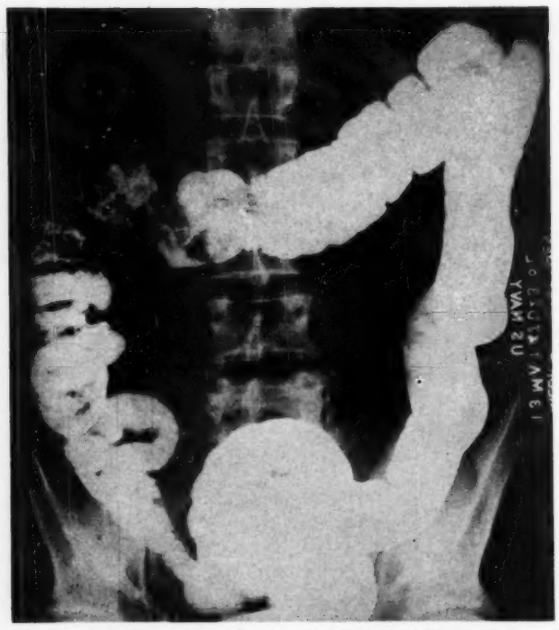

FIG. 4. Postoperative barium enema following closure of the colostomy revealing an essentially normal colon.

of the herniated bowel and omentum had been accomplished, it was observed that the bowel was of a rather lifeless appearance and reddish-purple color, as was the omentum, and neither bled freely following trauma. Hot towels were applied to this segment of bowel and omentum but vitality did not return.

After exploration of the abdomen an effort was made to deflate the distended proximal bowel by aspiration through a trocar, but this was only partially successful due to the semi-solid nature of the large intestinal contents; and obstruction of the colon at the site of herniation through the diaphragm was so complete that collapse of the intrathoracic portion of bowel could not be accomplished. The herniated bowel and great omentum were reduced manually but due to inflammatory adhesions within the sac this was accomplished with great difficulty. In so doing the devitalized herniated segment of bowel gave way at one point, resulting in fecal contamination within the hernia sac high in the thoracic cavity. However, there was no gross perforation of the hernial sac and, as well as could be ascertained, the pleural cavity proper was not entered. A pneumothorax was not observed during operation and postoperative radiographic examination of the chest revealed that none was present. Following reduction of the hernia, the hernia sac and the right subphrenic area were thoroughly irrigated with normal saline. The opening in the diaphragm was repaired with interrupted mattress sutures of silk. No attempt was made to excise the hernia sac. Both sulfanilamide and crystallin penicillin were placed within the thorax and in the upper abdomen prior to closure. A loop colostomy of the transverse colon was then done with excision of the devitalized portion of that structure. The abdomen was closed in layers without drainage.

The postoperative course was stormy. Thirty-six hours after operation the right phrenic nerve was crushed under local anesthesia in order to provide temporary paralysis of the right diaphragm while healing of that structure was taking place. Pleural effusion developed on the tenth postoperative day and thoracentesis yielded 1,800 cubic centimeters of serosanguineous fluid and 900 cc. of creamy purulent material. Closed drainage was instituted but proved inadequate and it was necessary to perform rib resection and institute open drainage. At this operation a multiloculated suppurative pleurisy was encountered and approximately 1,700 cc. of clotted fibrin, purulent material, coagulated blood and serum were evacuated. Progressive clearing of the chest followed this procedure and the thoracotomy wound was permitted to close approximately one month later. Closure of the colostomy was accomplished ten weeks after the original operation. Convalescence following this procedure was uneventful. When complete healing of his abdominal wound had occurred, the patient was discharged to duty in excellent condition. A gastrointestinal series and barium enema (Fig. 4) were normal at that time and radiographic examination of the chest showed normal findings except for moderate elevation of the right diaphragm as a result of the crushed right phrenic nerve.

COMMENTS

The case presented has as its most unusual aspect the probability that the opening through the right diaphragm was congenital. The hiatus was situated in the tendinous portion of the dome of the right diaphragm. There is no known

embryologic derivation for this type of faulty development. The hiatus was oval in shape with smooth, non-adherent edges. During the operative procedure the bowel in the thorax was irreducible because of distention and adhesions distal to the hiatus. The surgeon was able to pass his finger completely around the diaphragmatic opening. All previous reports have indicated that traumatic diaphragmatic herniations have rough, adherent edges as their primary characteristic. These are invariably conducive to adhesion formation. It was also found that the long axis of the oval diaphragmatic hiatus was at right angles to the radial tear to be expected in cases of trauma. Finally, when the large intestine and omentum were removed from the thoracic cage and restored to the peritoneal cavity, no pneumothorax resulted indicating that a true pouch of peritoneum was present. While it is true that the hernia sac was not definitely identified, the sac was probably present but impossible to dissect free from the posterior thoracic wall.

SUMMARY

A case of right-sided diaphragmatic hernia in an adult is presented. It is believed that the hernia was congenital.

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INTRAFOLLICULAR OVARIAN PREGNANCY*

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PRIMARY ovarian pregnancy is a rare type of ectopic gestation which can be detected only after a careful study of the removed specimen which fulfills the criteria specified by Spiegelberg[1] in 1878. The elasticity, resiliency and blood supply of the ovary is much better than that of the fallopian tube. Therefore, ovarian pregnancy may continue for a much longer period than the tubal variety. In fact in a recent case report of an ovarian pregnancy which went to term exploration of the abdomen resulted in a live infant and mother.[2] The usual end result, however, is quite similar to that of tubal pregnancy.

Our present day statistics began when Van Tussenbroek[3] reported the first authentic case in 1899. In 1928 in his monograph on extrauterine pregnancy, Schumann[4] collected a total of forty-three cases. Courtiss[5] reported one case and found eighty-eight authentic cases which appeared in the literature up to 1942. The addition of the case report which is being presented and the thirty-one[2,6–31] cases which appeared in the literature between 1942 and 1948 brings the number of reported cases to 121.

CASE REPORT

Mrs. D. C. was seen for the first time at her home about 9:00 P.M. on February 4, 1948. At the time she complained of severe stabbing pain in the right lower abdomen which started an hour before while having sexual intercourse. Her medical, surgical and family history were noncontributory. Menstruation began when she was twelve years of age with intervals ranging from twenty-eight to thirty days, lasting six to seven days, moderate in amount with no associated symptoms. During the past four months she noted that her menses were moderately profuse with some clots and were associated with mild abdominal cramps. She also noticed a slight vaginal spotting for a few hours about one week before the onset of her last period. Her last menstrual period occurred January 22, 1948, exactly fourteen days ago. She was married six years, gave birth spontaneously at term to a living female infant five years ago and had a spontaneous abortion at three months' gestation about four years ago. Venereal and pelvic inflammatory disease were denied.

Physical examination revealed a twenty-five year old white female lying in bed appearing not acutely ill. Her temperature was 98.4°F., pulse 72, blood pressure 120/80, respiration 20. The breasts, heart and lungs were normal. The abdomen was moderately tender to deep pressure over the right lower quadrant without rigidity or palpable masses.

In view of the fact that the pain had subsided by the time we saw her, and also because of the minimal findings, it was believed that the acute episode of abdominal pain was caused by ovulation. The patient was given a sedative and was advised to report to the office for further examination.

On February 9, 1948, five days later, the patient felt only slight discomfort in the right lower abdomen. General physical examination was essentially the same as before. Pelvic examination disclosed a multiparous introitus, normal external genitalia, small rectocystocele, slight erosion and laceration of the cervix; the corpus uteri was of normal size, firm in consistency, freely mobile and not tender; the right adnexal region disclosed an ovarian cyst which was two times the size of the corpus; it was moderately tender and somewhat fixed. The left adnexa was negative. At the time it was thought that the patient had a right cystic ovary which was partially twisted to cause the original acute abdominal episode. In view of the fact that the symptoms were minimal a short period of observation was thought to be the management of choice in order to rule out a simple follicular or corpus luteum cyst of the ovary.

* From the Department of Obstetrics and Gynecology of the Chicago Medical School and the Mt. Sinai Hospital, Chicago, Ill.

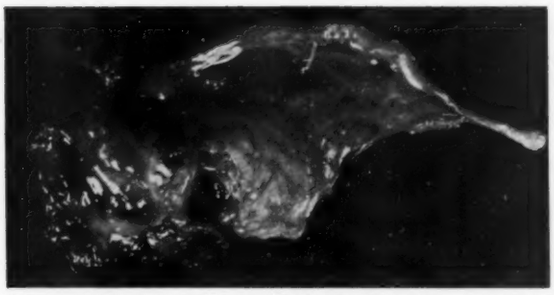

FIG. 1. Gross specimen indicating an hemorrhagic ovary, fallopian tube, the mesosalpinx and the right utero-ovarian ligament.

The patient was re-examined on February 16th, March 2nd and March 22, 1948. The pelvic findings were approximately the same except for a slight decrease in the size of the cystic mass. During this period of observation there was a moderately profuse menstruation February 21st to 28th and another apparently normal menstrual period between March 18th and March 22nd. Persistence of the cyst for almost seven weeks under observation was considered an adequate test of time for conservative management and surgery was decided upon.

On March 24, 1948, a preliminary diagnostic dilatation and curettage was followed with an exploratory laparotomy. The uterus was normal in size, anteflexed in the midline and normal in consistency. The left fallopian tube and ovary were normal. The right ovary was cystic, hemorrhagic in appearance, about one and a half times the size of the corpus uteri. The utero-ovarian ligament and the right fallopian tube were normal in appearance except that the fimbriated end which was very distinct with a patent ostium was slightly adherent by two or three fine fibrous bands over the surface of the ovary. There was a small Morgagni's cyst also adherent to the surface of the ovary. (Fig. 1.) A right salpingo-oophorectomy and appendectomy was done and the abdomen closed in layers. Following operation her course was uneventful. She was discharged from the hospital on the eighth postoperative day in good condition.

The pathologic study disclosed that the uterine scrapings were of the interval stage. The fallopian tube was 12 cm. long and was free with a delicate mesosalpinx. The fallopian tube was easily probed showing no evidence of occlusion. The fimbriated end was distinct. The ostium was patent and a Morgagni's cyst was present and fixed to the ovary. The ovary measured 6½ by 4 by 3½ cm. The uterine pole with the utero-ovarian ligament was easily recognizable. The greater part of the ovarian surface was brown and formed by a thick capsule measuring 2 cm. The cut section of the ovary disclosed dark red and brown blood clots which could not be separated from the inner lining of the ovarian wall. The whole specimen gave the impression of a hemorrhage into the ovary.

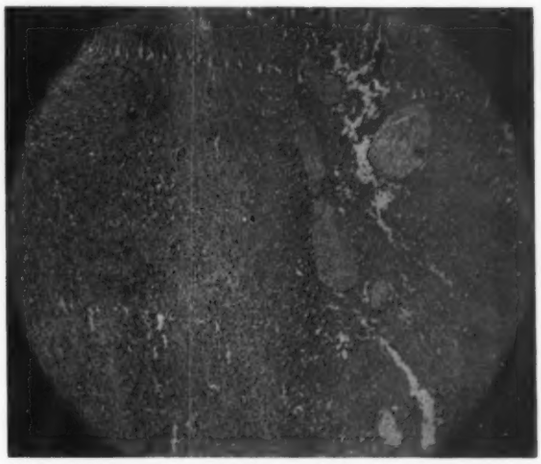

FIG. 2. Microphotograph containing ovarian stroma with shadows of chorionic villi.

Microscopic study disclosed isolated chorionic villi which showed very advanced necrosis. A section from the brown part of the ovary revealed vascular granulation tissue with a large amount of pigment. A section from the wall of the ovary showed ovarian stroma containing follicles and corpus albicantia. In this section chorionic villi were found. (Fig. 2.) The uterine scrapings showed endometrium in the interval phase. The pathologic diagnosis was as follows: (1) tumor of right ovary, intrafollicular ovarian pregnancy with hemorrhage; (2) uterine scrapings, interval phase; (3) appendix, fibrosis.

COMMENTS

The criteria of Spiegelberg requiring[2] that the fallopian tube of the affected side must be intact; that the fetal sac must occupy the affected ovary; that the ovary must be connected to the uterus with the utero-ovarian ligament and that definite ovarian tissue should be found in the wall of the fetal sac were well demonstrated in our case.

The general opinion that ovarian pregnancy may occur much more frequently than it has been noticed is well borne out by this case. This patient had an ovarian pregnancy which was apparently resolving without much difficulty to the patient. Had the patient not called a doctor during the first episode of her abdominal cramps it is likely that she would not have sought any further medical care.

SUMMARY AND CONCLUSION

1. This case of primary ovarian pregnancy fulfills all the criteria as outlined by Spiegelberg.

2. The diagnosis of ectopic pregnancy could not be made before the specimen was removed because the patient did not present even the slightest suspicion of pregnancy.

3. It was only because an ovarian cyst persisted for seven weeks that a right salpingo-oophorectomy was done and another proven case of primary ovarian pregnancy was found.

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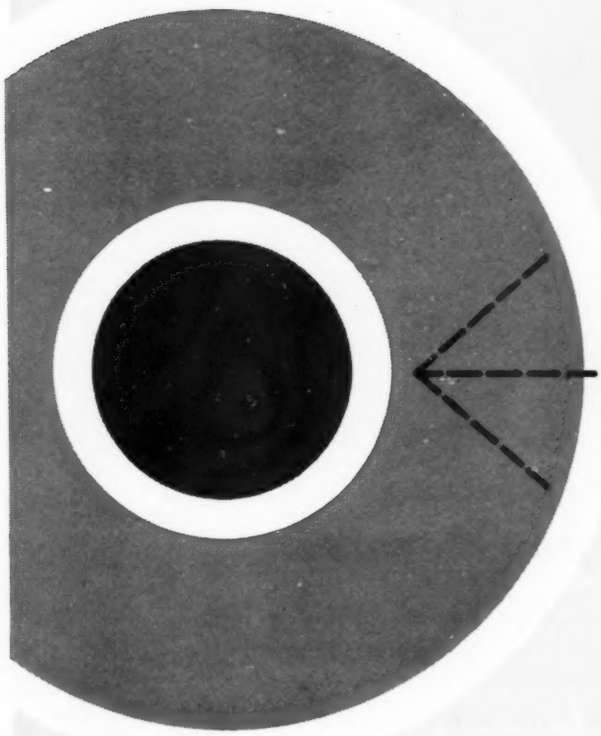

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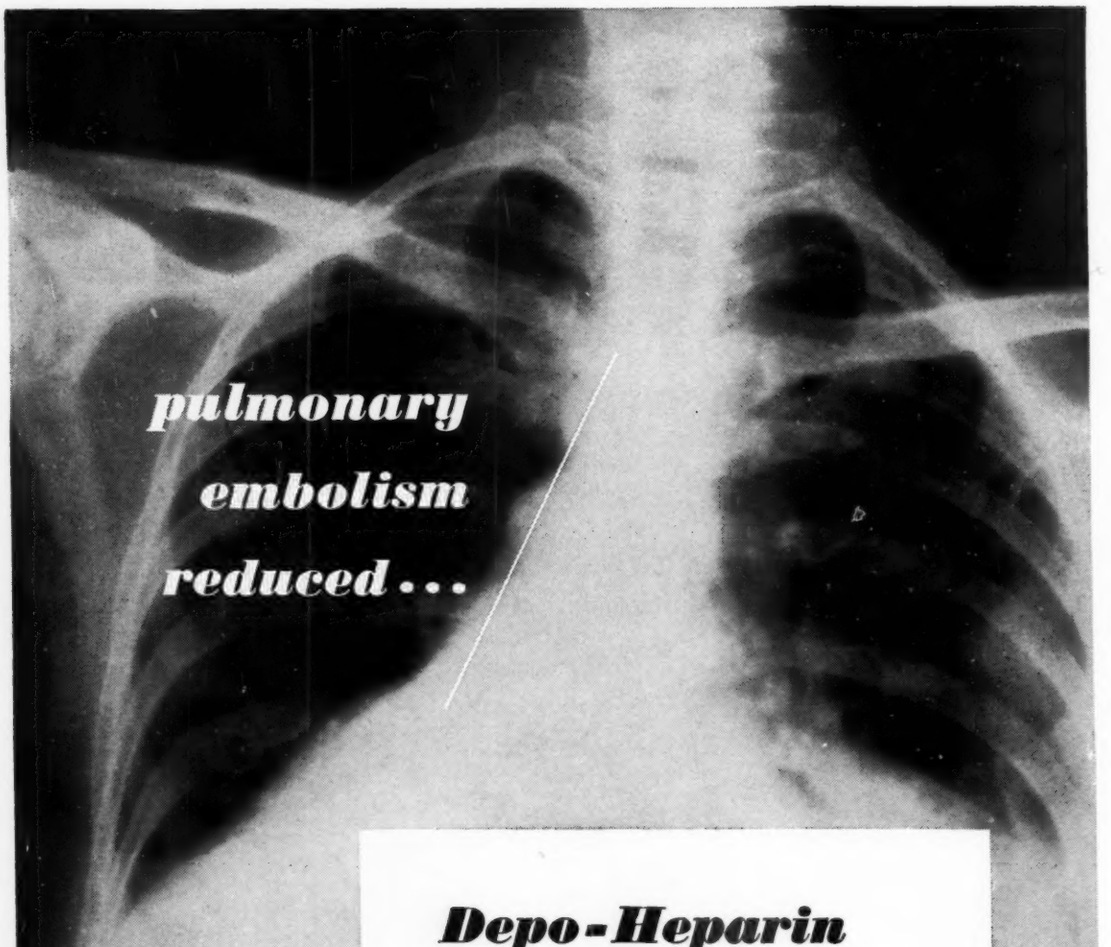

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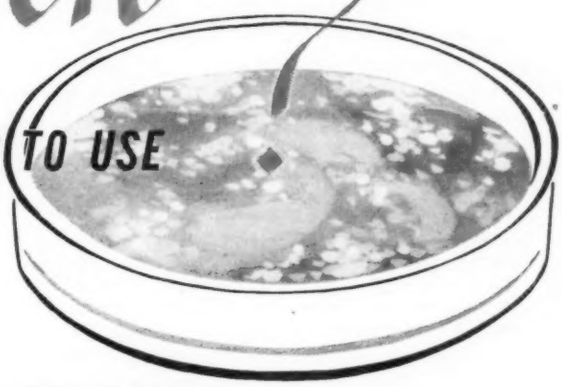

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(*continued from page 28*)

THE 14th Congress of The Societe Internationale de Chirurgie will be held in Paris from September 24 to 29, 1951, under the presidency of Professor René Leriche, Member of the Institute of France. In 1949, during the Congress in New Orleans, the General Assembly by unanimous vote ratified the decision to replace the old type of program of comprehensive reports of selected topics by a new one consisting of addresses on vital problems of the day. The speakers are to be chosen from amongst the members of the society who are best qualified. A list of the subjects selected and the names of the speakers is submitted as follows: (1) pulmonary resection for tuberculosis, X; (2) the future of the cavity remaining after pneumonectomy, C. Price Thomas (London); (3) extracorporeal circulation to facilitate surgery of the cavities of the heart, Jongbloed (Utrecht); (4) restorative vascular grafts and the effect of cold on the tissues as related to transplantation, E. Rehn (Freiburg i. Br.); (5) allergy and abdominal surgery, P. Valdoni (Roma); (6) surgery of the sympathetics and vascular diseases of the brain, A. De Sousa Pereira (Porto); (7) spontaneous internal fistulas of the biliary system, P. Mirizzi (Cordoba-Argentine); (8) the postoperative malady, E. Elman (St. Louis); (9) influence of the conceptions of Speranski, Leriche and Ricker upon the future of surgery, C. Henschen (Bâle); (10) sequellae of postoperative venous thrombosis, C. Bauer (Mariestad) and H. Peiper (Mayence); (11) portal hypertension, A. Blakemore (New York).

ACTH and cortisone may contain healing powers for hopeless diseases and might have application in high altitude flying. There is no doubt, according to the Dean of the Yale University School of Medicine, that in these hormones medicine has found two powerful agents of great potential value for the treatment of several heretofore incurable diseases. They may have important applications in the treatment of the shock that follows injuries or burns, and at least one group of investigators has found that they enable animals to resist oxygen lack, a finding that may be of importance in enabling pilots to reach higher altitudes without collapsing.

COMPETENT authorities estimate that 8 to 10 million patients suffer from attacks of recurrent, incapacitating migraine-type headaches. Even though millions of words have been used to describe different kinds of pain, the visualization of so common an occurrence as headache is no small task. In spite of the almost incredible difficulties, Sandoz Pharmaceuticals undertook to produce a motion picture, with sound, which would visualize the basic causes of headache, the mechanism of head pain and demonstrate the correct treatment. After spending more than two years on the production of this film, Mr. S. M. Fossel, the Assistant General Manager of Sandoz Pharmaceuticals, announced the completion of "Migraine—Its Diagnosis and Treatment."

Diagrams and animation are profusely used throughout the film to describe headache, the patient's personality traits and the results to be expected from proper therapy. In migraine, psychogenic factors are most important. It is for this reason that the film carries one patient through the complete cycle of childhood, when there were predisposing factors, to her adult and business life.

In spite of the problems involved in presenting a concise, informative visualization of the basic facts on this subject, "Migraine—Its Diagnosis and Treatment" has accomplished the objective through the will to put forth an interesting technical and educational motion picture.

MARKING the third anniversary of the national blood program, the American Red Cross announced today that blood donations must be tripled during the coming year to meet pyramiding demands of the military forces and civilian hospitals. "The Defense Establishment, alone, will need more than a million pints of blood by July 1st, and we cannot yet estimate the requirements for civil defense," said E. Roland Harriman, Red Cross President. "We must also continue to meet the

(*continued on page 44*)

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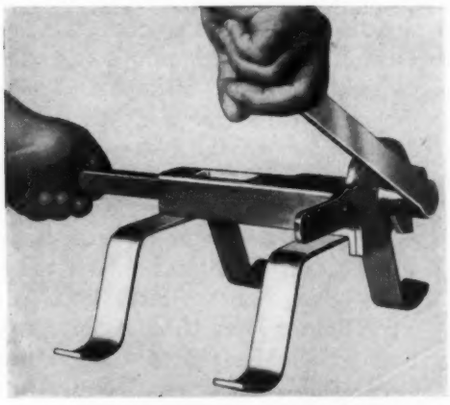

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(*continued from page 40*)

demands of the every-day ill in our civilian hospitals."

VICE Admiral Joel Thompson Boone, Medical Corps, United States Navy, retired, has accepted appointment as Chief Medical Director of the Veterans Administration. Admiral Boone will take over his duties at the Veterans Administration by April 1, 1951. He succeeds Dr. Paul B. Magnuson whose resignation previously presented has been accepted by General Gray effective January 15, 1951. Dr. Magnuson, who is a prominent orthopedic surgeon, sacrificed a large private practice in Chicago to come with the Veterans Administration and assist in the reorganization of its medical department soon after General Omar N. Bradley was appointed Administrator in 1945. He has been with the Veterans Administration ever since and was appointed Chief Medical Director by Administrator Gray in January, 1948. The government has lost a valuable physician and administrator.

A GROUP of distinguished doctors and medical laymen who were delegates and observers at the World Medical Association Convention in New York recently toured the extensive Lederle Laboratories research and production facilities at Pearl River, N. Y. At the plant the doctors, who represented the medical profession from eight foreign countries, met and talked with Lederle scientists who have been prominent recently in the development of various new medical products such as aureomycin, mumps vaccine, rabies vaccine and vitamin B_{12}.

EIGHT new grants for research in nutrition were announced today by Dr. E. Gifford Upjohn, President of The National Vitamin Foundation. The Foundation makes grants-in-aid of research semi-annually on January 1st and July 1st of each year. The new grants became effective on January 1, 1951, and total $60,700.

GEORGE Thomas, Assistant Curator in charge of Division of Medicine and Public Health, of the Smithsonian Institution, has accepted, on behalf of that organization, a display presented to them by Davis and Geck, Inc., of Brooklyn, New York, suture manufacturing subsidiary of American Cyanamid Company. This new display replaces the present exhibit on surgical sutures and shows some of the newer technics and developments in this field. The new display depicts in full color the story of modern surgical sutures. Stress is placed on the development of the various kinds of sutures from their source through various stages of manufacturing, research and testing and into actual use of the suture in the operating room.

ANOTHER bumper crop of babies started life's journey in the United States during 1950. By year's end the number of births will total nearly 3,700,000, which is only 5 per cent below the all-time high of 1947. This year was the fourth in succession in which the number of births exceeded 3,500,000.

THE National Gastroenterological Association announces its Annual Cash Prize Award Contest for 1951. One hundred dollars and a Certificate of Merit will be given for the best unpublished contribution on Gastroenterology or allied subjects. Certificates will also be awarded those physicians whose contributions are deemed worthy.

Contestants residing in the United States must be members of the American Medical Association. Those residing in foreign countries must be members of a similar organization in their own country. The winning contribution will be selected by a board of impartial judges and the award is to be made at the Annual Convention Banquet of the National Gastroenterological Association in September of 1951. All entries for the 1951 prize should be limited to 5,000 words, be typewritten in English, prepared in manuscript form, submitted in five copies accompanied with an entry letter, and must be received not later than June 1, 1951. Entries should be addressed to the National Gastroenterological Association, 1819 Broadway, New York 23, N. Y.

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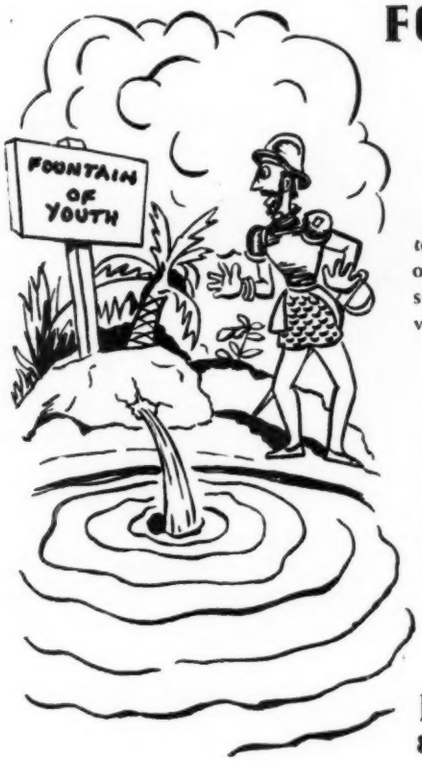

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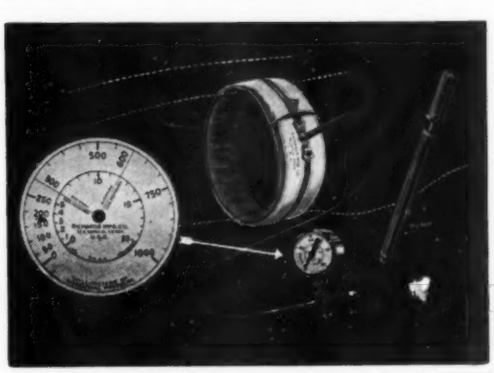

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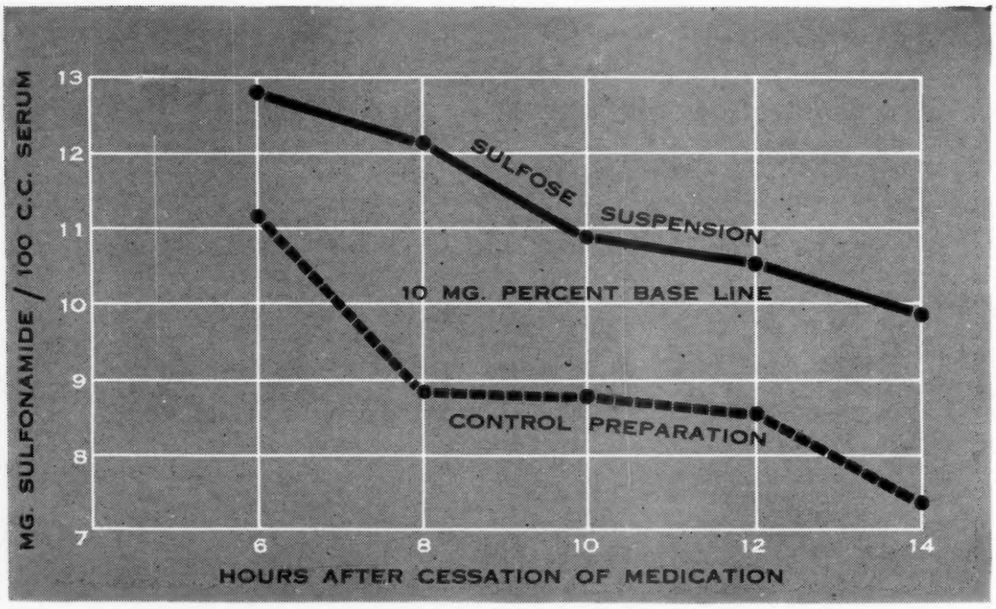

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